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GREEK ATOMIC ENERGY COMMISSION

**3<sup>rd</sup> NATIONAL REPORT OF GREECE  
ON COMPLIANCE WITH THE  
COUNCIL DIRECTIVE 2011/70/EURATOM  
OF 19 JULY 2011  
“Establishing a Community framework for  
the responsible and safe management of  
spent fuel and radioactive waste”**

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**3<sup>rd</sup> NATIONAL REPORT OF GREECE**

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<b>Report</b>	<b>Name</b>	<b>Position</b>
Prepared by	Mr. C.J. Hourdakis	Head of Licensing & Inspections Section, EEAE
	Mr. I. Kaissas	Licensing & Inspections Section, EEAE
Reviewed by	Mr. N. Kallithrakas - Kontos	EEDRA Alternate Chairman & EEAE Vice-Chairman
	Ms. E. Carinou	Deputy Head of the Licensing & Inspections Directorate, EEAE
Approved by	Mr. C. Housiadas	EEAE Chairman & EEDRA Chairman

## Abbreviations

**EEAE:** Greek Atomic Energy Commission

**EEAE-194/2018:** EEAE decision No Π/112/4364/2018, Appointment, composition and functioning of the National Committee for Radioactive Waste Management, Government Gazette Folio No. 194/YOΔΔ/05.04.2018

**EEDRA:** National Committee for Radioactive Waste Management

**ELKE:** Special Account for Research Grants

**ILW:** Intermediate Level Waste

**LLW:** Low Level Waste

**MD-1858/2015:** Ministerial Decision 131207/I3/20.08.2015, National policy on the management of spent fuel and radioactive waste, Government Gazette Folio No. 1858/B/27.08.2015

**MD-1103/2019:** Ministerial decision No 45872/2019 for the Procedures for the regulatory control of practices of ionizing radiation – approval and recognition of services and experts, Government Gazette Folio No. 1103/B/03.04.2019

**MD-4317/2020:** Ministerial Decision 97529/18-09-2020, National program of spent fuel and radioactive waste management – Second version, Government Gazette Folio No. 4317/B/02.10.2020

**Minister:** the Minister responsible for EEAE (currently, the Alternate Minister of Development and Investments)

**NatPro:** National Program on the SF & RW management. In this report the National Program refers to the **MD-4317/2020**.

**NCSR D:** National Centre for Scientific Research “Demokritos”

**NRWIS:** The centralized interim storage facility for RW, RM and RS management, operated by the Institute of Nuclear and Radiological Sciences & Technology, Energy & Safety (INRASTES) of NCSR D

**NTUA:** National Technical University of Athens

**PD-122/2013:** Presidential Decree 122/2013, Transposition to Greek legislation of Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste, Government Gazette Folio No. 177/A/12.08.2013

**PD-91/2017:** Presidential Decree 91/2017, Legislative, regulatory and organizational framework for the responsible and safe management of spent fuel and radioactive waste and amendment of the Presidential Decree 122/2013, Government Gazette Folio No. 130/A/01.09.2017

**PD-101/2018:** Presidential Decree 101/2018 Adaptation of Greek legislation to Council Directive 2013/59 / Euratom of December 5, 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionizing radiation, and repealing Directives 89/618 / Euratom 90/641 / Euratom, 96/29 / Euratom, 97/43 / Euratom and 2003/122/(EE L13 / 17.1.2014) - Establishment of radiation protection regulations, Government Gazette Folio No. 194/A/20.11.2018

**RM:** Radioactive Material

**RPR:** Radiation protection regulations. In this report, the PD-101/2018.

**RS:** Radioactive Sealed Sources

**RW:** Radioactive Waste

**SF:** Spent Fuel

**VLLW:** Very Low Level Waste

**VSLW:** Very Short Lived Waste

## A: Introduction

The Council Directive 2011/70/Euratom of 19 July 2011 “Establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste” has been transposed into the Greek legislation through the Presidential Decree PD-122/2013 as amended by PD-91/2017 and two Ministerial Decisions (MD-1858/2015 and MD-4317/2020). This legislation, together with PD-101/2018 that transposes the Council Directive 2013/59/Euratom of 5 December 2013 to Greek legislation, constitute the regulatory framework for Spent Fuel (SF) and Radioactive Waste (RW) management in Greece.

Greece has signed the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management on 5 September 1997. The Convention has been ratified by the Parliament in 2000 (Law 2824/2000). In addition, Greece implements the IAEA Code of Conduct for the safety and the security of radioactive sources (RS) and its Supplementary Guidance on the Import and Export of Radiation Sources.

The present report is the 3<sup>rd</sup> national report of Greece under Article 14.1 of Council Directive 2011/70/Euratom. It provides basic information on the management of SF and RW and summarizes the developments and achievements within the reporting period of the last three years (2018-2021). During the reporting period, the “National Program” (NatPro) has been revised and published as ministerial decision on 2<sup>nd</sup> October 2020. The revision was necessary to facilitate the implementation and monitoring of the national program in a more realistic and effective manner.

This national report has been prepared by EEAE in accordance with the guidelines provided to Member States by the European Nuclear Safety Regulators Group (ENSREG) in the document of ENSREG Working Group 2, Guidelines for Member States reporting on Article 14.1 of Council Directive 2011/70/Euratom, January 2018. The national report has been notified to the National Committee for Radioactive Waste Management (EEDRA) for comments.

The information given in this report is consistent with the national report for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (publicly available at EEAE website [https://eeae.gr/files/anakoinoseis/reports/joint\\_convention\\_national\\_report\\_2020.pdf](https://eeae.gr/files/anakoinoseis/reports/joint_convention_national_report_2020.pdf)).

## Spent fuel and radioactive waste in Greece

Greece has no nuclear power plants. Therefore, SF management is relevant only with respect to the operation of the research reactor (GRR-1) at the National Centre for Scientific Research “Demokritos” (NCSR-D). GRR-1 is currently licensed for extended shutdown; the irradiated fuel was returned to the US Department of Energy (DoE) in February in 2019, under the agreement between NCSR-D and the US DoE. The remaining fresh LEU fuel elements are scheduled to be exported soon in Canada (to the McMaster University research reactor). In addition, the Department of Nuclear Engineering of the School of Mechanical Engineering of the National Technical University of Athens (NTUA) owns and stores nuclear material (fresh natural Uranium) for an out-of-use (dismantled) research sub-critical assembly.

RW in Greece originates from medicine, research and industry. RW have also been produced from the past operation of GRR-1 and other activities of NCSR-D. Today radioactive waste inventory includes RW from the past operation of the reactor (e.g. resins, graphite), disused sources, equipment and consumer products containing radioactive materials (RM), such as smoke detectors, lightning rods, navigation instruments etc., contaminated materials and contaminated objects with NORM. Short lived liquid or solid RW from the operation of medical and research laboratories are managed by decay and clearance. More details are provided in Section C in this report.

## Regulatory bodies and implementing organizations

The principal organizations / bodies involved in SF and RW management are:

### Regulatory body – Greek Atomic Energy Commission (EEAE)

EEAE is the competent regulatory authority for the control, regulation and supervision in the fields of nuclear energy, nuclear technology, radiological and nuclear safety and radiation protection. EEAE is operating as a public entity and enjoying full administrative and financial independence in relation to its duties. It is supervised by the Alternate Minister of Development and Investments (the Minister).

In 2014, with the Law 4310 (Government Gazette Folio No. 258/A/08.12.2014) titled “Research, Technological Development and Innovation and other provisions”, a separate chapter, chapter E, titled “Nuclear Energy, Technology and Radiation Protection - Greek Atomic Energy Commission” is included (articles 39 - 46).

### National Committee for Radioactive Waste Management (EEDRA)

The National Committee for Radioactive Waste Management (EEDRA) has been established since 2018 (05.04.2018) by EEAE-194/2018 decision, following provisions in PD-122/2013 as amended by PD-91/2017.

EEDRA is a 9-member collegiate body with advisory and supportive role towards the Minister on the implementation of the practical aspects of the national policy and national framework and on the coordination of the bodies involved in RW management. With the establishment of EEDRA the collaboration between the organizations/bodies involved in RW management and the coordination of actions is ensured.

### National Centre for Scientific Research “Demokritos” (NCSR) – Storage facility (implementer)

The NCSR is a self-administered governmental legal entity, under the supervision of the General Secretariat of Research and Innovation of the Ministry of Development and Investments.

NCSR consists of five Institutes. Among those, the Institute of Nuclear and Radiological Sciences & Technology, Energy & Safety (INRASTES) operates a centralized interim storage facility (NRWIS). Indicatively, the facility temporarily stores RW from the past operation of the GRR-1 research reactor (e.g. regeneration bed resins in drums, cemented sludge), historical waste and other RS and RW from research and industrial applications, disused sealed radioactive sources in gauges, industrial sources, neutron sources, lightning rods, smoke detectors, contaminated/activated metal objects.

The license of the NRWIS facility has been renewed by EEAE, for the interim storage of RW and disused RS, low activity RS dismantling (category 3-5), characterization of RW, overpackaging of old drums, re-sorting/ segregation of RW and clearance of radioactive materials. The legislative framework for the licensing of the facility is based on PD-101/2018, PD-122/2013 as amended by PD-91/2017.

Besides NRWIS facility, other institutions and laboratories of the NCSR use or store RS, RM and RW, as indicatively: Pu-Be sources; contaminated or activated objects from the GRR-1 at the reactor building; liquid waste and sludge in liquid waste tanks; sealed radioactive sources.

## Disposal facility

Greece does not have a RW disposal facility. Current plans and the progress during the reporting period are provided in this report. The NatPro defines the type of a future disposal facility as a combination of near surface facility with Engineered Barriers and surface trench disposal.

## Major elements of the national policy and the national program

The national policy, as provided in PD-122/2013 as amended by PD-91/2017, MD-1858/2015 and MD-4317/2020, includes the following:

- SF shall be returned to a supplier or producer country, according to an agreement in place before the import of the fuel in Greece. Spent fuel final disposal in Greece is not presently considered as part of the Radioactive Waste Management National Policy.

The repatriation of the irradiated - spent fuel was completed in February 2019; therefore, SF does not exist anymore countrywide. Some remaining non-irradiated fuel elements (about 15 kg of LEU, 19.75%), which are neither SF nor RW, are anticipated to be exported soon.

- Shipment of SF, RS, RM and RW follows transport and safeguards legislation. The nuclear material existing in Greece is subject to the control and regular inspection of IAEA and EURATOM Safeguards.
- RW produced in Greece shall be disposed within the national territory, unless an agreement is in place for export of the waste abroad, in line with European Union legislative requirements. Until the establishment of a national disposal facility, RW generated within the Greek territory shall be stored safely and securely in authorized storage facilities (at NRWIS or at RW producers' facilities) under regulatory control. The storage of RW, RS and RM does not constitute a final management solution. The import of RW within the country's borders for management, including disposal, is prohibited.
- For RS, repatriation or export for recycling are the preferred management option (back-end solution).
- For the VSLW originating from practices, as nuclear medicine or research laboratories, the decay and clearance options are applied.

Other relevant information is provided in Section D in this report.

## RW management principles

The protection of workers, public and environment is ensured by the application of radiation protection principles and the relevant provisions of PD-101/2018, PD-122/2013 as amended by PD-91/2017, MD-1858/2015 and MD-4317/2020.

Each practice, work or activity related to the SF and RW management, before approval for the first time shall be justified on the basis of socio-economic or other advantages granted in connection with possible health risks. Ongoing or existing SF and RW management practices can be reviewed by EEAE in the light of new and important evidence about their effectiveness. Unjustified SF and RW management practices are prohibited.

Dose constraints in terms of effective dose are set for the members of the public, as 100  $\mu\text{Sv}/\text{year}$  from the applied SF and RW management practices, 50  $\mu\text{Sv}/\text{year}$  from a single SF and RW management practice and 10  $\mu\text{Sv}/\text{year}$  from discharges of liquids or gases from a particular SF and RW management practice. Dose constraints for radiation workers are set by the licensee and approved by EEAE.



Safety requirements for the RW management and for the disposal of RW are provided in legislation (PD-122/2013 as amended by PD-91/2017), including licensee obligations, evaluation and verification of safety, location, design and construction, operation, maintenance, decommissioning etc.

In general, the IAEA waste classification is applied. Other special classes (like Legacy Waste, Graphite Waste, etc.) are also used, currently, to address the type and the origin of RW and to facilitate the characterization procedures. Wastes classified in these special classes will be reclassified into IAEA classification after their characterization. Characterization and classification of existing waste is in progress. Details on the classification criteria are provided later in this report (Section C).

Sealed RS, after their useful life, are returned to the manufacturer or to an authorized recycling facility abroad. Prior to the import of a RS, a legal written declaration from the source manufacturer for accepting back the source is necessary, as well as a legal written declaration from the RS user for undertaking all financial and administrative provisions to export the RS.

The inventory of RW, RS and RM is maintained by EEAE within the national radiation protection database and includes the necessary basic information, i.e. facility, location, operator, persons in charge, quantities, form, activities, etc. Recently, the IAEA ISRS platform is used.

### National Program

The second version of the national program (NatPro) has been prepared pursuant to paragraph 7 of PD-122/2013 as amended by PD-91/2017 and in accordance with the requirements of the Council Directive 2011/70/Euratom. The second version of the NatPro has been published in the Official Gazette in October 2020 as a Joint Ministerial Decision (MD-4317/2020).

The second version of the NatPro revises and replaces the initial (1<sup>st</sup> version) of the NatPro (of 2015). The revision was necessary to accommodate the experience gained during the implementation of the 1<sup>st</sup> NatPro, to consider the EEDRA recommendations and all recent developments and work being conducted by the EEDRA and EEAE on the RW management. The significant milestones are revised and clear timeframes are set for their implementation. The second version is anticipated to facilitate the implementation and monitoring of the national program in a more realistic and effective manner.

The NatPro, constitutes of two major objectives: (a) the recycling of the disused RS and other RM which includes eight (8) specific actions and (b) the operation of an Interim Storage Facility and a Final Disposal Facility which includes five (5) specific actions. These actions are accompanied with milestones and timelines, preliminary cost estimation, financing and inventories of SF and RW. Details are presented in sections I, K and Annex of this report.

### Peer reviews

In November 2017, an IAEA follow up mission of the Integrated Regulatory Review Service (IRRS mission) was conducted. Radioactive waste management was included in the scope of the mission. As indicated in the follow up report the progress made since the initial mission in 2012 includes, inter alia, the following: (i) the update of the regulatory framework, (ii) the development and implementation of an integrated management system in EEAE (iii) the implementation of the graded approach in the main regulatory function and (iv) the enhancement of the national regulatory framework for the management of radioactive waste.



An IAEA ARTEMIS mission has been invited to Greece in order to obtain an independent expert opinion and advice on radioactive waste and spent nuclear fuel management, decommissioning and remediation. The mission is scheduled for 2023.

## B. Recent developments

The main developments and achievements during the last three-year reporting period are summarized as follows:

### Completion and revision of legislation

1. Completion of the transposition of the European Basic Safety Standard Directive: The transposition of the Directive has been completed. A series of legislative documents has been entered into force including a Presidential Decree, 3 Ministerial Decisions, EEAE Decisions and Guidance documents uploaded at EEAE website. The legislative basis for the licensing of the RW management facility lies in the PD 101/2018, the MD 45872/2019 and the PD 122/2013 as amended by PD 91/2017. IAEA safety standards are also used by EEAE for the review and assessment of the safety of the RW management facility.
2. In 2020, the second version of the national program for the management of spent fuel and radioactive waste was published as Joint Ministerial Decision (MD-4317/2020).

### National program revision and implementation

The most significant changes introduced in the second version of the NatPro (MD-4317/2020) compared to the 1<sup>st</sup> (initial) NatPro concern:

a. Specific Milestones and Timeframes

The actions of the NatPro are grouped in two categories:

*(i) Recycling of sealed radioactive sources (RS) and radioactive material (RM);* eight specific actions with explicit timeframes are considered. These actions concern the export for recycling of disused RS of category 1, 2 and 3, the investigation and the finding of the best solution for the export for recycling of disused RS of category 4 and 5, as well as the export of the remaining non-irradiated (fresh) fuel elements of the GRR-1 and the fresh natural uranium elements owned by NTUA from an out-of-use research sub-critical assembly. These actions are expected to be completed in June 2021 and June 2022, respectively.

*(ii) Operation of the national facility for the interim storage and management of RW;* five (5) specific actions are considered to be completed by December 2023. These actions include: the establishment of a Memorandum of Understanding (MoU) between the Greek Atomic Energy Commission (EEAE) and the National Centre for Scientific Research “Demokritos” (NCSR) on the responsibilities, duties, collaboration and joint activities for the RW management, pertaining the discrete roles of regulator and operator; the specification of the legislation for the establishment of the RW disposal facility; decision making for the expansion of the existing interim storage facility of the NCSR to a RW disposal facility; finalizing the analysis about the disposal facility, including the strategy for the environmental impact studies, the safety analysis report, the financing and the environmental inspections and surveillance system for the post-closure period.

- b. Updated and verification of the Inventory and Classification of Radioactive Waste; The NatPro specifies the quantities of the different classes of RW.
- c. Technical solutions for the disposal facility:

EEDRA has specified the most appropriate technical solution for the disposal facility which is a combination of an engineered near surface disposal facility and a surface trench. Within this framework, the expansion of the existing interim storage facility of the NCSR D to a RW disposal facility will be investigated, firstly. If this solution fails, the siting of the disposal facility will be investigated furtherly.

d. Measures for the post-closure of the disposal facility.

A specific action addresses plans and measures for post-closure period of the disposal facility, including environmental impact study, safety case, environmental monitoring and descriptive specific financing plan.

e. Financial arrangements – Cost

The NatPro estimates the costs of the implementation of its actions and provides details on the financial arrangements and sources. The polluter pays principle is followed; however other financial resources have been identified and addressed in the NatPro, as presented in the relevant parts of this report (section I).

## Functioning of the EEDRA

Following the provisions of PD-122/2013 as amended by PD-91/2017 (article 15, paragraph 3), EEDRA was constituted on 05.04.2018 (EEAE-194/2018). Since then, several meetings have been performed and working groups (WG) have been formed to investigate various RW management topics. The most important outcomes from the WGs and the EEDRA plenary sessions include:

- the formulation and the proposal of the most appropriate option and technical solution / option for the RW disposal facility;
- the review and endorsement of the second version of the NatPro;
- the estimation of costs for the upgrade of the existing NCSR D RW management facility and the establishment and operation of a disposal facility;
- proposals for the management of disused RS, following the graded approach;
- proposals for conduction of environmental studies and assessments by independent experts regarding the expansion of the NCSR D RW management facility to a RW disposal facility.

## Progress on RW disposal options decision making

Since the publication of the first NatPro in 2015 and the functioning of EEDRA, more knowledge has been gained and a comprehensive understanding has emerged on the applicable options that can meet the country's needs for disposal of RW.

In particular, the combination of the engineered near surface disposal facility and the surface trench is considered as the best option for the RW disposal.

Based on initial feasibility assessment and cost estimations for the establishment of the disposal facility, the expansion of the NCSR D RW management facility to a disposal facility has been introduced in the current NatPro as the solution that needs to be firstly assessed. This option has important advantages over the establishment of a disposal facility in a new site, for reasons, among others, of security, avoidance of RW transport, existing expertise and availability of initial resources, as well as fast implementation and lower cost. All safety and environmental impact assessments and studies shall be conducted, according to the NatPro actions.

In case the disposal facility will need to be established in a new site, the NatPro prescribes specific steps and procedures, including the determination of “white” sites (i.e. a number

of potential sites to conform certain general criteria for RW disposal) as well as the performance of the safety and environmental impact assessments and studies.

Finally, the NatPro outlines plans and actions for the post-closure of the disposal facility including financial resources availability, passive and active measures, environmental monitoring, water radioactivity monitoring, etc.

## **Finance of the NatPro implementation**

Following the publication of the legislation acts (PD-122/2013 as amended by PD-91/2017, MD-4317/2020 and EEAE-194/2018) and the appointment and functioning of the EEDRA (on 05.04.2018), the costs of the NatPro actions have been estimated and funding mechanisms and resources have been identified and allocated. Section I of this report provides the relevant information.

## **Repatriation of the irradiated fuel and nuclear material**

According to Article 4.1c of PD-122/2013, spent fuel shall be returned to a supplier or producer country, according to an agreement which shall be in place before the import of the fuel in Greece.

The repatriation of the irradiated fuel of the GRR-1 research reactor was completed in February 2019, according to the agreement (Contract No DEGI09-05SR22469, 22 Aug. 2005) between the NCSR and the US Department of Energy Savannah River Operations Office. Following this, Greece does not possess spent - irradiated fuel, anymore.

The remaining LEU fresh fuel elements, which are not SF or RW, are scheduled to be exported soon (to the McMaster research reactor in Canada); the operator (NCSR) has finalized the procurement and operational arrangements for the shipment. Consultation with European Supply Agency (ESA) EURATOM and actions in line with the terms and conditions of the afore-mentioned contract are in progress. It is expected that the export of fresh fuel will be completed in 2021.

Regarding the fresh natural uranium elements stored in the National Technical University of Athens (NTUA) a specific action was included in the current NatPro for the repatriation of the elements.

## **Exporting of disused sources**

During the reporting period, EEAE had performed a survey in an attempt to identify all disused RS stored in facilities countrywide. The updated inventory of the disused RS of categories 1, 2 and 3 has been included in the second version of the NatPro; the timeframes for their repatriation or export for recycling to authorized facilities has also been set. These disused RS, concern RS that had been used for medical, industrial and research applications (and more specifically, five (5) of cat. 1, seven (7) of cat. 2 and sixty-one (61) of cat. 3).

During the reporting period, 4 (out of the 5) of cat. 1 disused RS have been exported for recycling. In addition, one (1) RS of cat. 2 and four (4) RS of cat. 3 have been re-used. For the rest of the disused RS, EEAE has informed the users, including the relevant authorities in charge (e.g. Ministry of Health) for the users' obligations for exporting them. Following the NatPro, it is anticipated that all cat. 1, 2 and 3 disused RS will be exported for recycling until the end of 2023.

Regarding the cat. 4 and 5 disused RS, EEAE and EEDRA will initiate actions to identify routes and solutions for the RS export for recycling.

## RW inventory

The IAEA SRIS application was introduced to register the national RW, in parallel to the national registry. The IAEA classification system was retained. Currently, the following waste classes are in use: VLLW / LLW / ILW / Legacy Waste / VLLW (Liquid-Sludges) / Graphite Waste / Contaminated Material / Consumer Products. As the characterization of the waste of some special classes (like Legacy Waste, Graphite Waste) progresses these classes will be adapted to the IAEA's ones. For instance, after the characterization of the Legacy Waste, they will be included in the VLLW, LLW and maybe a small amount of them in the ILW classes. The total volume of the RW is estimated less than 200 m<sup>3</sup>. This estimation excludes metal objects from NORM industry contaminated with salt accumulations of NORM, because the total volume of these contaminated metal objects (almost 100 m<sup>3</sup>) can be reduced drastically with appropriate treatment procedures.

A detailed resume of the inventory is presented in the Annex RW Inventory, including the disused RS, even if they are not considered as RW.

## Safety issues

The centralized interim storage facility for RW (NRWIS), operated by the Institute of Nuclear and Radiological Sciences & Technology, Energy & Safety (INRASTES) of NCSR D has been further upgraded regarding working procedures and management system. The license of the facility was renewed by EEAE for the interim storage of RW and disused RS, low activity sources dismantling, characterization of RW, overpackaging and re-sorting/segregation of RW and RS and clearance of RW. The legislative bases for the licensing of the facility are PD-101/2018, PD-122/2013 as amended by PD-91/2017, MD-1878/2015 and MD-4317/2020.

The regulatory control of the facility has been conducted systematically, through inspections and review and assessment processes by EEAE. The inspection results have been forwarded to the facility and the follow up process is in progress. The conditions of the license and the respective timeframes are monitored by EEAE.

## International peer reviews

- At the request of the Government of Greece, an IAEA Integrated Regulatory Review Service (IRRS) Follow-up mission was conducted from 20 to 24 November 2017. The purpose of the IRRS Follow-up mission was to review Greece's progress against the recommendations and suggestions identified in the initial IRRS mission (20 to 30 May 2012). Overall, the IRRS team concluded that Greece, mainly through EEAE, has been responsive to each recommendation and suggestion made in the initial mission in 2012, and continues to place appropriate focus on implementing a framework that provides for effective protection of public health and safety. 26 out of 28 recommendations and 9 out of 10 suggestions identified in 2012 have been closed. More details are provided in section L in this report.
- An ARTEMIS mission has been invited in order to obtain an independent expert opinion and advice on SF&RW management, decommissioning and remediation (the mission is scheduled for 2023).

## Training, Research and Developments

During the reporting period, important training and R & D have taken place.

- Personnel of EEAE and NCSR D participate in the European Joint Program on Radioactive Waste Management, EURAD. EURAD vision is the European collaboration towards safe RW management, including disposal, through the development of a

robust and sustained science, technology and knowledge management program that supports timely implementation of RW management activities and serves to foster mutual understanding and trust between Joint Program participants.

Specifically, EEAE and NCSR D participate in most of the subtasks (2-6) of the EURAD Working Package 9 (WP9) “Waste management routes in Europe from cradle to grave (ROUTES)” and in its extension for small inventory member states.

- A significant number of scientific and technical staff from EEAE and NCSR D participated in IAEA training activities and programs. Indicatively, the national participation includes: 8 participations in RER/9/143 (Enhancing radioactive waste management capabilities), 11 in RER/9/146 (Enhancing capabilities in member states for the planning and implementation of decommissioning projects), 14 in INT/9/182 (Sustainable cradle-to-grave control of radioactive sources).
- An IAEA workshop “Training Event on the Safe Decommissioning of Facilities” 20-24 May 2019, Athens, Greece was hosted by NCSR D.
- In addition, several persons from EEAE participated in other IAEA workshops and meetings, as CoC, MedNet, etc.

## Challenges

Points for improvement, opportunities and challenges have been identified as follows:

- Development of a new database platform for RW: This will facilitate the registration of the RW and the development of the RW inventory according to EU and IAEA classification schemes, thus achieving homogenization of data. Currently, the IAEA SRIS platform is used in parallel with the existing national radiation protection database, which maintains the RW inventory. The development of the new database platform has started, expecting to be completed in 2022 and fully operated in 2023.
- Characterization of Legacy RW mainly derived from the past activities of the NCSR D and the GRR-1 research reactor, in order to complete the gaps in the national inventory.
- Further upgrade of the NRWIS, especially for the conditioning and the characterization of RW and RM.
- Implementing the 1st objective of the NatPro for the disused RS to be exported for recycling.
- Implementing the initial steps for the disposal facility, including site studies (e.g. geological, environmental impacts) and safety assessments methodologies, considering the transdisciplinary approaches needed.

## C. Scope and inventory (Article 2, Article 12.1 (c), Article 14.2 (b))

### Scope

According to the definitions in PD-122/2013 as amended by PD-91/2017, RW includes radioactive material in gaseous, liquid or solid form for which no further use is foreseen or considered as RW by the Greek state or by a natural or legal person whose decision is accepted by the Greek state, and which is controlled as RW by EEAE under the legislative and regulatory framework of the Greek state.

Spent fuel was produced from the past operation of the GRR-1 and was repatriated in February 2019. The remaining (non-irradiated) fuel elements are anticipated to be exported soon.

RW in Greece originates from medicine, research (including the past operation of the research reactor GRR-1) and industry. The vast majority of them are VLLW or LLW. A very small amount of waste that may be classified as ILW, mainly some parts from the dismantled core of the reactor, will also possibly exist. Today RW includes:

- a. Solid and liquid RW (regeneration bed resins, activated and contaminated objects, etc), RS originated from the past activities and operation of the research reactor GRR-1. These RW and RS are temporarily stored inside the reactor building, storage spaces in retention tanks and the NRWIS.
- b. Disused and orphan RS and RM for which, by EEAE decision, there is a clear and urgent need – from the safety, security and radiation protection point of view - for immediate management. This category includes RS and RM detected in scrap metal, illicit trafficking, illicit actions, emergency situations, as well as RS and RM from bankrupt companies. These RS and RM are transferred to the NRWIS.
- c. Disused RS and RM, derived from activities of industrial, medical, research or other facilities, which cannot be repatriated or exported to a recycling facility abroad. They are temporarily stored in the premises of their holders, in storage spaces, until their final management. The possession and the temporary storage of such RS and RM are under regulatory control. To this end, specific terms are included in the conditions of the facility operation license, which are subject to regulatory control.
- d. Equipment and consumer products containing RM (e.g. smoke detectors, lightning rods, fluorescent signs, measurement devices, etc.), which completed their useful life and cannot be exported for recycling. These materials are temporarily stored either at the holder's premises, or at authorized facilities for radioactive lightning rod / smoke detector management. They may also be transferred to the NRWIS depending on mutual agreement.
- e. Radioactive materials or contaminated objects containing naturally occurring radioactive materials (NORM), which are stored on site, in temporary storage spaces, until their final management. Furthermore, several tens of tones of soil containing very small amounts of NORM (above exemption levels), produced as by-product of phosphoric fertilizer industry, are deposited in notified/authorized NORM sites.
- f. Liquid and solid RW from the operation of medical and research laboratories, which are managed by decay and clearance. The relevant files and records are kept by the operator and are subject to regulatory control.

The IAEA radioactive waste classification is applied. The 100 days and 30 years half-lives apply for distinguishing between very short lived and long lived RW, respectively.

Specific criteria for the RW classification are as follows:

Very low level waste (VLLW) contains isotopes with half-lives less than 30 y and activities about two orders higher than the exempted values. Waste with radionuclides with higher half-lives are considered as VLLW too (e.g.  $^{226}\text{Ra}$ ), if the activity is very low. Examples are



objects using  $^{226}\text{Ra}$  for luminance, smoke detectors with  $^{241}\text{Am}$ , soil with NORM  $^{226}\text{Ra}$  at low concentrations, etc. Low level waste (LLW) do not contain long lived (i.e. with  $t_{1/2} > 30$  y) radionuclides. Long lived radionuclides (i.e. with  $t_{1/2} > 30$  y) could be present in LLW, if the concentration is lower than 400 Bq/g on average for long lived alpha emitting radionuclides, or 10 kBq/gr for long lived beta and/or gamma emitting radionuclides.

In general, for very short lived waste (VSLW) ( $t_{1/2} < 100$  d) decay and clearance are employed.

Apart from the classification of the RW based on activity concentration and radionuclide half-life, the RW are classified according to their origin, type and disposal option as follows:

- a. Solid and liquid RW from the *past activities and operation of the GRR-1 research reactor*. Indicatively, resins, sediments, historical waste, activated and radioactive materials are mentioned. These RW are estimated to be VLLW, LLW. The most suitable option for their disposal is in engineered near surface disposal facility and/or in a surface trench.
- b. *Radioactive material (RM)*, as indicatively radioactive lightning rods, fire detectors, devices with fluorescent materials. The expected disposal method is in an engineered near surface disposal facility.
- c. RW that will result from the *decommissioning* of the GRR-1 research reactor and other facilities (e.g. isotope production cyclotrons). The RW are expected to be VLLW, LLW and possibly, in small quantities ILW. The most suitable disposal option is in an engineered near surface disposal facility and / or in a surface trench.
- d. *Hospital RW (VSLWs)* from nuclear medicine practices, including contamination objects with radiopharmaceuticals (gloves, syringes, vials, etc.), patient excreta (toilet paper, urine collectors, diapers, etc.), food residues. Hospital RW are managed in-situ; solid RW are temporarily stored and cleared when the clearance levels are reached; liquid RW are discharged into the sewer system either directly or through delayed tanks to reduce their radioactivity.
- e. *Disused* radioactive sources, orphan sources and radioactive materials (RM), which are temporarily stored in the facilities under the regulatory control. The preferred management option is recycling before RS and RM become RW. Since there are no radioactive material recycling facilities in Greece, their export from the country to an authorized recycling facility is the preferred option. For sources and materials that cannot be exported for recycling, they will dispose in an engineered near surface disposal facility.

## Inventory of RW and future RW

EEAE keeps the national RW inventory, where the main information is kept (i.e. RW holder / facility, radionuclides, type, quantities – volume - weigh, etc).

In addition EEAE maintains the RS inventory including the following information: License holder: Facility / laboratory / organization; Radiation protection officer; License: expiration – conditions; Location within the facility; Source device: manufacturer, isotope, type – form, s/n (if available); Source activity and reference date.

Regarding the future RW, it is noted that the research reactor GRR-1 is under extended shutdown, so no SF or other RW will be generated from its operation. It has been assessed that the future RW, additional to the existing, may arise mainly from:

- a. the decommissioning of the research reactor GRR-1. The inventories considered in the NatPro (provided in the Annex of the present report) include estimations of the RW that will be generated from the GRR-1 decommissioning;
- b. orphan sources from illicit trafficking and scrap metal shipments;
- c. sources from bankrupt facilities that the owner will not be able to manage.



EEAE performs updates of the inventories regularly based on the data from the national radiation protection database. The most recent data for the national inventory is provided in the Annex.

## **D. General principles and policies (Article 4)**

### **Policy for RW management**

According to Article 4.1 a and b of PD-122/2013, RW produced in Greece shall be disposed within the national territory, unless an agreement is in place for export of the waste abroad, in line with European Union legislative requirements. Until the establishment of a national disposal facility, waste shall be stored safely in a licensed storage facility.

Regarding sealed radioactive sources, according to the Article 5.6 of MD-1858/2015, formal acceptance of the importer and manufacturer shall be in place, prior to the import of a sealed source, to return the source back to the manufacturer after the end or its utilization period.

Other important elements of the national policy are as follows:

- The import of SF&RW for disposal purposes within the borders of Greece shall be prohibited.
- An SF&RW producer shall have the primary responsibility for the management of the SF&RW concerned, until their natural decay to the regulated clearance levels or their shipment to an authorized spent fuel or radioactive waste management facility in Greece or abroad. In any case, the SF&RW producer shall undertake all obligations deriving from the management method and shall bear the cost of their management.
- The radioactive waste producer shall take all necessary measures to minimize the volume and activity of the radioactive waste, where reasonably feasible. If applicable, these measures shall be under regulatory control in the context of the authorization of the relevant practice.
- All bodies involved in the use or management of radioactive sources shall ensure that the radioactive sources may be reused by other interested parties, where possible, before they become radioactive waste.
- Storage is not a final management solution.
- Radioactive materials and sources or radioactive waste resulting from emergencies, accidents or incidents, whose existence, in EEAE's opinion, entails a risk to radiation protection or public health, shall be temporarily stored in an authorized interim SF&RW storage facility pending a final decision concerning their management (most usually, the NRWIS).
- Safety shall be the highest priority of the national policy on SF&RW management, and it shall also promote a safety culture, by properly adopting the relevant legal provisions and providing education, training and information.
- The necessary information concerning the planning and implementation of SF&RW management actions shall be posted on the Internet, where it shall be publicly accessible.
- The requirements, decisions taken, proposed solutions, as well as regulatory inspections and checks concerning safe SF&RW management shall follow a graded approach.

## Shipment of SF and RW

Shipment of radioactive waste from Greece to other European countries or to a third country is addressed in PD 83/2010 (147/A/3.10.2010) “Compliance of Greek legislation with Council Directive 2006/117/Euratom of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent nuclear fuel” according to which EEAE shall inform accordingly the EURATOM prior to shipment. Shipment is allowed to countries that have a relevant agreement with EURATOM or they are contracting parties to the Joint Convention and have a national radioactive waste management program and existing management facilities that can handle the type of the shipped waste.

## E. National framework (Article 5)

### Main legislation

In 2020, the “National Program” has been revised and published as ministerial decision on 2<sup>nd</sup> October 2020. The revision was necessary to facilitate the implementation and monitoring of the national program in a more realistic and effective manner.

In 2018, the National Committee National Committee for the RW management (EEDRA) was appointed (decision EEAE-194/2018).

A list of the laws and regulations relevant to RW management are given below.

#### Radioactive waste

- Presidential Decree No. 122/2013, Transposition to Greek legislation of Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste, Government Gazette Folio No. 177/A/12.08.2013;
- Presidential Decree No. 91/2017, Legislative, regulatory and organizational framework for the responsible and safe management of spent fuel and radioactive waste and amendment of the Presidential Decree 122/2013, Government Gazette Folio No. 130/A/01.09.2017;
- Ministerial Decision No. 131207/I3/20.08.2015, National policy on the management of spent fuel and radioactive waste, Government Gazette Folio No. 1858/B/27.08.2015;
- Ministerial Decision No. 97529/18.09.2020, National program of spent fuel and radioactive waste management- Second version, Government Gazette Folio No. 4717/B/02.10.2020.

#### Nuclear installations

The legislative framework with regard to nuclear installations is as follows:

- Act No. 854/1971, On the terms regarding the establishment and operation of nuclear facilities, Government Gazette Folio No. 54/A/18.03.1971;
- Presidential Decree No. 610/1978, Establishing terms and procedures in licensing Public Power Corporation to construct a nuclear power plant on a specific site, Government Gazette Folio No. 130/A/23.08.1978;

*In early 1980s, a decision was made to exclude nuclear power electricity generation. Therefore, the above two pieces of legislation have never been used and can be considered as archival pieces of legislation.*

- Presidential Decree No. 60/2012, Establishing a National framework for the nuclear safety of nuclear installations (transposition of the Council Directive 2009/71/Euratom of 25 June 2009), Government Gazette Folio No. 111/A/03.05.2012.

#### Nuclear research reactors

- Ministerial Decision 84631/07.08.2020, Amendment of the Decision no. P/112/305/2012 (B' 2877) Main requirements – principles of nuclear safety and regulatory control of research reactors as amended by Decision no. 91175/2017 (B' 1991) transposing 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 (L 219 /25.7. 2014), Government Gazette Folio No. 3389/B/13.08.2020;
- Ministerial Decision 91175/31.05.2017, Amendment of the Decision no. P/112/305/2012 (B' 2877/26.10.2012) Basic requirements – principles of nuclear safety and regulatory control of research reactors (transposition of the Directive 2014/87/Euratom), Government Gazette Folio No. 1991/B/09.06.2017;
- Ministerial Decision P/112/305/2012, Basic requirements – principles of nuclear safety and regulatory control of nuclear research reactors, Government Gazette Folio No. 2877/B/26.10.2012.

#### Implementation of the International obligations

- Law No. 2480/1997, Ratification of the Nuclear Safety Convention, Government Gazette Folio No. 70/A/14.05.1997;
- Law No. 1636/1986, Ratification of the Convention on the physical protection of nuclear material, Government Gazette Folio No. 106/A/18.07.1986;
- Law No. 1758/1988, Ratification of the Protocol Amending the Convention on Third Party Liability on the Field of Nuclear Energy of 29 July 1960, as it was modified by the Additional Protocol of the 28 January 1964, Government Gazette Folio No. 44/A/10.03/1988;
- Law No. 1937/1991, Ratification of the International Convention in case of a Nuclear Accident or Radiological Emergencies, Government Gazette Folio No. 35/A/13.03.1991;
- Law No. 1938/1991, Ratification of the International Treaty on Early Notification in case of a Nuclear Accident, Government Gazette Folio No. 36/A/13.03.1991;
- Law No. 2824/2000, Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, Government Gazette Folio No. 90/A/16.03.2000;
- Law No. 3787/2009, Ratification of the Protocol amending the Convention on Third Party Liability in the field of nuclear energy of 29 July 1960, as amended by the additional protocol of 28 January 1964 and by the Protocol of 16 November 1982, Government Gazette Folio No. 140/A/07.08.2009;
- Law No. 3990/2011, Amendment of the Convention of Physical Protection of Nuclear Materials, Government Gazette Folio No. 159/A/13.07.2011.

#### Safeguards and non-proliferation

- Law No. 437/1970, Ratification of the non-proliferation treaty signed on the 1 June 1968, Government Gazette Folio No. 49/A/26.02.1970;
- Safeguards agreement between Greece and IAEA signed on 17.11.1972;

- Ministerial Decision No. 5408/E3/2362/Φ.NSG/31.08.1993, Control on transfer of nuclear materials, armament and technologies affecting national Defense and Security, Government Gazette Folio No. 730/B/21.09.1993;
- Law No. 2805/2000, Ratification of the additional protocol, Government Gazette Folio No. 50/A/03.03.2000.

#### Radiological protection

- Law No. 181/1974, Protection against ionizing radiation, Government Gazette Folio No. 347/A/20.11.1974;
- Presidential Decree No. 101/2018, Adaptation of the Greek legislation to Council Directive 2013/59/Euratom of December 5, 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/ (EE L13/17.1.2014) - Establishment of radiation protection regulations, Government Gazette Folio No. 194/A/20.11.2018;
- Ministerial Decision No. 45872/2019, Procedures for the regulatory control of practices of ionizing radiation – approval and recognition of services and experts, Government Gazette Folio No. 1103/B/03.04.2019;
- Ministerial Decision 135966/30.12.2019, Implementation of existing exposure situation strategies, Government Gazette Folio No. 5116/B/31.12.2019;
- Ministerial Decision 43374/4.10.2020, National action plan for addressing long-term risks from radon exposure, Government Gazette Folio No. 1881/B/13.08.2020;
- EEAE Decision No. 4a/261/2019, Establishment of mechanisms for the recognition of radiation protection experts, medical physics experts and occupational health services, authorization of dosimetry services and the approval of radiation protection officers, Government Gazette Folio No. 2460/B/21.06.2019;
- EEAE Decision No. 4b/261/2019, Establishment of the dose constraints for public exposure from planned operation of a specified radiation source, Government Gazette Folio No. 2460/B/21.06.2019;
- EEAE Decision No. 4c/261/2019, Specific measures for the safe management and control of high activity sealed sources, Government Gazette Folio No. 2460/B/21.06.2019;
- EEAE Decision No. 4d/261/2019, Submission and access to the results of individual monitoring, Government Gazette Folio No. 2460/B/21.06.2019;
- EEAE Decision No. 4/266/2020, Description of incidents involving or possibly involving accidental or unintentional exposure during medical exposure to be reported directly to the Greek Atomic Energy Commission, Government Gazette Folio No. 214/B/03.02.2020.

#### Establishment of the regulatory body

- Law No. 1733/1987, Transfer of Technology, inventions, technological innovation and establishment of the Greek Atomic Energy Commission, Government Gazette, Folio No. 171/A/22.09.1987;
- Presidential Decree No. 404/1993, Organization of the Greek Atomic Energy Commission, Government Gazette Folio No. 173/A/05.10.1993;
- Law No. 4310/2014, Research, Technological Development and Innovation and other provisions (Chapter E' - Nuclear Energy, Technology and Radiation Protection

– Greek Atomic Energy Commission (EEAE), Government Gazette Folio No. 258/A/08.12.2014.

### Emergency preparedness

- Law No. 3013/2002, Upgrade of the General Secretariat for Civil Protection, Government Gazette Folio No. 102/A/1.5.2002, as in force;
- Presidential Decree No. 101/2018, Adaptation of the Greek legislation to Council Directive 2013/59/Euratom of December 5, 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/ (EE L13/17.1.2014) - Establishment of radiation protection regulations, Government Gazette Folio No 194/A/20.11.2018 (Section 5 and Annex XI);
- Ministerial Decision No. 1299/2003, Approval of the General Plan for Civil Protection, under the Code Name Xenokratis, Government Gazette Folio No. 423/B/10.04.2003 (in particular, the Annex R of Xenokratis deals with the response to an emergency situation from important and extensive radioactivity contamination due to a nuclear accident);
- Decision of the General Secretary for Civil Protection, Guidelines for the management of CBRN threats, October 2020;
- Decision of the General Secretary for Civil Protection, General Plan for Emergency Response due to accidents during Road and Rail Transport of Dangerous Goods according to ADR / RID regulations, 1<sup>st</sup> version, June 2020.
- Decision of the General Secretary for Civil Protection, Guidelines for the management of out-of-control depositions of materials of unknown origin, 2<sup>nd</sup> version, August 2021, ref. 7519/12-08-2021.

### Other relevant legislation

- Presidential Decree No. 83/2010, Transposition of Council Directive 2006/117/Euratom of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel into the Greek legislative framework, Government Gazette Folio No. 147/A/03.09.2010;
- Ministerial Decision P/112/1057/2016/01.02.2016, Establishment of requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption, in compliance with the Council Directive 2013/51/Euratom of 22th of October 2013, Government Gazette Folio No. 241/B/09.02.2016.
- Ministerial Decision 11592(FOR)1125/1999, Mandatory installation and use of equipment for the detection of radioactive materials in scrap metals and for their illicit import, Government Gazette Folio No. 1633/B/18.08.1999.

### Legislation in progress

- Presidential Decree for the internal organization of EEAE is in the process of being issued.

## **Bodies in charge for RW management**

According to PD-122/2013 as amended by PD-91/2017 the main bodies involved in RW management are:

#### **a. The Minister**

The Minister responsible for EEAE has ultimate responsibility for the management of SF & RW and for the approval and implementation of the NatPro, as well as to supplement, extend, maintain and implement the existing national programme and national policy.

#### **b. Greek Atomic Energy Commission (EEAE)**

EEAE is the competent authority - Regulatory Body. Details on EEAE duties and responsibilities are provided in other sections in this report.

#### **c. National Committee for Radioactive Waste Management (EEDRA).**

The National Committee for Radioactive Waste Management (EEDRA) has been established by EEAE-194/2018 act and amended by EEAE-325/2018, following PD-91/2017 provision. EEDRA is a collegiate body with advisory and supportive role towards the Minister on the implementation of the practical aspects of the national policy and national framework and on the coordination of the bodies involved in RW management. EEDRA is a 9-member committee nominated upon an EEAE act and consists of the EEAE Chairman (EEDRA President) and the EEAE Vice Chairman (EEDRA Alternate President), a representative of the ministry responsible for EEAE (currently, Ministry of Development and Investments/General Secretariat of Research and Innovation), representatives of the Ministry of Environment, Ministry of Finance, Ministry of Development and Ministry of Health, a representative of the General Secretariat of Waste Management Coordination, a representative of EEAE and a representative of NCSR. With the establishment of EEDRA the collaboration between the organizations/bodies involved in RW management and the coordination of actions are ensured.

The role of EEDRA is:

- a) To update the NatPro of RW management from production to disposal in accordance with Articles 11 and 12 of PD-122/2013, taking into account the needs of the country and the national policy.
- b) The preparation of financial plan and proposing funding sources for the implementation of the NatPro for RW management.
- c) The presentation to the Government of studies for the implementation of actions under the NatPro.
- d) The monitoring and evaluation of the process and progress of the implementation of the actions undertaken under (c) above.

#### **d. License holder**

The license holder operates a SF & RW management facility or conduct practices and activities with SF & RW management. The licensee has the prime responsibility for the safety and radiation protection during whole lifetime of a management facility, according to the legislation and the applicable safety standards. The license holder of a RW disposal facility shall belong to the public sector.

#### **e. Producer of RW**

The RW producer possesses an authorization to perform a practice or activity that generates RW. The RW producer prime responsibilities and financial obligations are presented in previous parts in this report. The producer, also, has the obligation and responsibility to follow the binding principles of the National Policy and the relevant national guidelines and international standards.



#### **f. The national facility for interim storage and management (EEPADRA)**

EEPADRA is one facility designated to have a special function in unplanned situations. In addition to the interim storage and management of radioactive waste, EEPADRA is meant to accept the interim storage and proper management - until reaching a settlement for their final management - of orphan radioactive sources and materials, which must be managed for safety and security reasons, upon a reasoned opinion from EEAE.

Currently, the NRWIS (the only existing interim storage facility in the country) covers the basic functional role of EEPADRA, on the basis of a Memorandum of Understanding (MoU) concluded between EEAE and NCSR, as provided for in article 5(B) of the NatPro.

### **Coordination of the Bodies in charge**

The Minister has the ultimate responsibility for the management of SF & RW in the country and the approval and implementation of the NatPro.

EEAE is the competent authority for authorization and licensing of SF & RW management facilities and practices. EEAE performs regulatory inspections to all RW management facilities ("License Holder") and to facilities that produce RW from the applied practices ("Producers of RW").

EEDRA, being a collegiate body, coordinates the activities of the ministries involved in SF & RW management.

### **Safety Requirements and Responsibilities**

#### **a. Responsibility of the license holder**

Articles 7.1, 15.4 and 15.5 of PD-122/2013 as amended by PD-91/2017 explicitly assign the prime responsibility for safety of SF & RW management facilities or activities to the license holder and the producer. SF & RW management actions of a facility are assessed by EEAE during the authorization process.

#### **b. Authorization**

According to PD-101/2018 and PD-122/2013 as amended by PD-91/2017 (chapter 4, article 16) each practice, work or activity related to the RW management requires authorization in accordance with the current legislation, taking into account a graded approach. In the various stages of a RW management facility lifetime the following authorizations are required: (a) Feasibility License; (b) Establishment License in a specific site; (c) Design approval; (d) Operation License; (e) Decommissioning License; (f) Approval for site release from regulatory control.

In the process of the regulatory control, the findings of EEAE from inspections and safety evaluations of the SF and RW management facilities are documented and made publicly available.

#### **c. Inspections**

EEAE performs regular and ad hoc inspections to ensure compliance with the regulatory requirements. The findings are recorded in inspection reports and notified to the licensee. Indicatively, the number of inspections that have been performed at the interim storage facility NRWIS, the main RW management facility in the country, were 9 in the period of reference.



During the inspection, the licensee is required to allow and facilitate unrestricted access for inspectors at any point of the facility, access to documents or other sources of information concerning the safety of SF and RW management and allow communication with any member staff. In the event that the licensee refuses or impairs the conduct of the inspection, EEAE may request the assistance of the police authority.

EEAE may require measures or improvements, when necessary, especially if deviations from the terms of the license or the essential safety requirements of SF and RW management facilities are observed.

In case of failure by a licensee to the regulatory requirements, EEAE may revoke or suspend the authorization issued and may impose administrative sanctions in accordance with the applicable provisions on enforcement.

#### d. Integrated Management Systems

According to PD-122/2013 (article 7.4), license holders shall implement an integrated management system, including a Quality Assurance (QA) program. In addition, the end-user, which is the RW producer in certain cases (e.g. industrial applications, nuclear medicine or research laboratories), shall implement QA program, which are subjected to regulatory control.

The most important elements of the QA shall include Records and Document Control System, Radioactive Waste Management Review, Personnel Meetings, Surveillance and Maintenance of Instrumentation, Sampling Quality Control, Handling, Storage and Shipping, Quality Assurance Records and Training Program.

Currently, the QA program of the NRWIS, is based on:

- Document Standardization and Codification.
- Handling of Incoming and Outgoing Documentation.
- Organization and Responsibilities of the personnel.

#### e. Human and financial resources

The PD-101/2018 and PD-122/2013 as amended by PD-91/2017 provide general requirements for human and financial resources of the licensee. Information for the available human and financial resources of the NRWIS storage facility were provided in the application for the operation license and found adequate in the regulatory review for the current activities in the facility.

For the import of RS, licensing process imposes that full financial provisions are made by the licensee for waste management and the return of the RS to the manufacturers.

#### f. Public information and perception

The information and public participation in the decision-making process for the management of RW is set by the provisions of article 10 of PD-122/2013 as amended by PD-91/2017 on transparency. Article 15.7 states that the bodies in charge (i.e. the Minister, EEAE, EEDRA, the license holder, the RW producer and the EEPADRA) are required to provide the public with the necessary information and the possibility to participate effectively in the decision-making process concerning the management of SF & RW in accordance with national law and international obligations, provided this does not jeopardize security issues.

#### g. Financing

According to the articles of PD-122/2013 as amended by PD-91/2017, the SF and RW producer bears all costs for the management of the SF and RW produced.

The plan for the NatPro financing is elaborated by EEDRA. The Minister shall ensure the implementation of the financing plan, which will not necessarily draw on the state budget but also in raising resources through, as indicative, projects, structural funds, recovery of the deposit fund, etc.

An independent deposit fund with separate code has been created in EEAE Special Account for Research Grants (ELKE) for the financial security of the management of RW, RS and RM. More details are presented in section I in this report.

#### h. Other elements to improve the national framework

A number of means have been deployed in order for the Greek regime to be responsive to changes in technology, international best practice/standards and lessons learned from international operating experience. Such means are outlined below.

Greece participates effectively to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management since 2000 as well as to other international treaties/conventions and bilateral agreements in the area of radiation safety and implements the Code of Conduct on the Safety and Security of RS and its supplement for import – export – transport of RS.

In the context of continuous improvement, Greek scientific and technical staff members participate actively to relevant IAEA and EU projects and to several international workshops and seminars in this field.

## **F. Competent regulatory authority (Article 6)**

EEAE was initially established by an Act in 1954. The organization has been re-established with a different scheme (as competent radiation safety authority) in 1987. In 2014, with the Law 4310 (Government Gazette Folio No. 258/A/08.12.2014) titled “Research, Technological Development and Innovation and other provisions”, in which a separate chapter, chapter E, titled “Nuclear Energy, Technology and Radiation Protection - Greek Atomic Energy Commission” is included (articles 39 - 46, article 90), the obsolete framework (Law 1733/1987, Legislative Decree 181/1974) is replaced by a new operation framework for EEAE. The major improvements, concern, inter alia, EEAE effective independence, enforcement means, inspectors’ role and inspection procedures, licensing authority and transparency enhancement. The current legal framework (Law 4310/2014) provides terms on impediments and incompatibilities in the appointment of the Board members (Article 44 of Law 4310/2014). This ensures the avoidance of conflicts of interests that could unduly influence regulatory decision making. EEAE is governed by a 7 member Board.

The effective independence of EEAE in the decision making process is ensured by the fact that the Board makes autonomous decisions on safety matters, without political or other interference. These decisions, as well as the minutes of the Board meetings are made open to the public through the EEAE’s web site. Moreover, EEAE staff members are not allowed to have other job positions in the private or public sector.

EEAE organizational structure was published in the form of a Presidential Decree in 1993. At present, a new Presidential Decree on the internal organization of EEAE has been approved by the government and is in the final stage of issuance. Following IRRS mission findings, the new internal organization of EEAE provides for the operational separation between its regulatory functions and scientific and technical services.

EEAE employs a sufficient number of about 75 qualified and competent staff to carry out its tasks. Most of EEAE personnel holds a degree of high level education and dispose

specialized scientific expertise (M.Sc. and/or Ph.D.). Their continuous training, the participation in EEAE E&T activities and the participation in scientific networks and international fora and activities is encouraged in order to gain the knowledge and experience required for the fulfillment of their tasks.

EEAE financial resources come from the public budget and from licensing fees and radiation protection services. The accounts and fiscal reports of the EEAE are subject to the control of the Audit Council. These data and fiscal reports are published on the EEAE website and submitted to the President of the Hellenic Parliament and the Minister alongside the annual report and the budget for the coming year.

EEAE implements an integrated management system based on GSR part 2; in 2013 it was certified in accordance with the requirements of ISO 9001:2008 standard, which incorporates all functions and accreditations of EEAE. In December 2016, the IMS was updated, fulfilling the requirements of the revised ISO 9001:2015.

## G. License holders (Article 7)

### General safety requirements

General Safety Requirements, pertaining in particular to radioactive waste management, are provided in Article 7 of PD-122/2013. These requirements define the responsibilities of the license holders regarding:

- The periodic safety assessments.
- The demonstration of the safety of the facility, covering all stages of the facility lifetime (development, operation, decommissioning, closure), including normal conditions and events or accidents considered in the facility design.
- Measures for accident prevention and mitigation of their consequences, including the verification of the safety barriers and of the organizational procedures, in order to avoid significant exposure of the workers and the public.
- Management systems and quality assurance.
- Adequate human and financial resources.

The PD-122/2013 as amended by PD-91/2017 provides additional safety requirements for both predisposal management and disposal of radioactive waste, throughout the different stages of a facility lifetime, including siting, design and construction, operation, maintenance, modification and utilization, and decommissioning or closure of facilities.

### Safety assessments

Articles 5.1.f, 13.2, 15.4 and 15.5 of PD-122/2013 as amended by PD-91/2017 provide that the prime responsibility for the safe management of SF & RW, including financing aspects and the compliance with the safety principles and radiation protection regulations rests with the license holder and the RW producer. Licensees are required to implement a policy for SF and RW management that sets high priority on safety and promotes the safety culture, by appropriate administrative structure, with clear allocation of responsibilities and fixed communication lines. Furthermore, licensees are required to establish and implement an appropriate quality assurance program and management system, a nuclear security program and a program of education and continuous training for those employees engaged in tasks related to safety, radiation protection and emergency response.

According to article 13.2 of PD-122/2017 as amended by PD-91/2017, the license holder is required to assess the safety of the installation in a systematic manner. The assessment of safety and security is documented in safety analysis documents and covers all stages of

facility lifetime, considering the implications of ageing. The assessment of safety and security analysis reports shall be updated periodically, and whenever appropriate, taking into account operating experience, changes or new knowledge, with respect to the particular characteristics of the site and the facility, international experience and developments in research and technology. The facility's safety and security level is verified through analysis, monitoring, audits and inspections to ensure that it remains at all stages of life in accordance with the design, safety requirements and operating conditions limits.

Regarding the NRWIS, the only RW management facility in the country, its operation license was last renewed in 2019 with a validity period of 2 years (until end 2021). Authorization is granted for the following practices: interim storage of RW and disused RS; low activity sources dismantling; characterization of RW; over-packaging of waste drums and RS as well as re-sorting/ segregation of RW; clearance of RW.

Improvements, regarding the format and content of the safety documentation of the interim storage facility NRWIS, have been identified during the facility licensing. Among them, the radiological hazards to the public, although are considered to be limited, it has been requested to be further assessed quantitatively in the context of a safety analysis, taking into account the guidance provided in IAEA safety standard WS-G-6.1, Storage of Radioactive Waste, IAEA, 2006. Respective licensing terms and timeframes were officially delivered to NRWIS in order to take appropriate measures. The EEAE safety evaluation reports / inspection reports to NRWIS have been made publicly available (posted to EEAE's web site).

Other facilities that produce VSLW from their practices (e.g. nuclear medicine, research laboratories) submit radiation protection reports within the renewal of their license, where, among others, RW management is addressed. Practical guidance was developed by EEAE to facilitate the applicants in assessing with simple means the exposure levels possibly to be caused by the RW discharges from medical, education and research facilities.

## Accident prevention and mitigation of consequences

According to the legislation, in each facility there is an internal emergency preparedness plan in case of a radiological accident or event, which is subjected to regulatory review. Moreover, in article 7.3 and 13.1 of PD-122/2013 as amended by PD-91/2017 it is provided that license holders shall implement measures for the prevention of accidents and for the mitigation of their consequences in order to protect the workers and the public from significant exposures to radiation.

The emergency plan for the NRWIS facility is based on the assessment of the possible hazards that might arise: (i) during the RW management activities; (ii) in case of fire; (iii) in case of larceny. The assessment consists of tracking and recording the dangers and risks that threaten the safety and health of the personnel, the general public and the environment.

In particular, a safety analysis, including a qualitative accident analysis and specification of the waste acceptance criteria of the NRWIS, have been conducted by the operator. One of the most important hazards, due to the location of the facility, has been identified to be an external fire (wildfire). This hazard has been evaluated and appropriate preventive measures have been identified in collaboration with the National Fire Service for the minimization of the impact of a fire on the facility. The emergency plan of the facility is in line with the respective Special Response Plans in Case of a Radiological or Nuclear Emergency (referred to as ESARPEA) that has been drafted based on the GSR Part 7 methodology.

## IMS and QA programs

According to article 7.4, 13.1 and 13.2 of PD-122/2013 as amended by PD-91/2017, the license holders are required to establish and implement management systems, including quality assurance (QA), which give due priority to safety in SF and RW management. The purpose of the management systems and QA is to ensure that all planned and systematic actions necessary for the satisfactory operation of structures, systems, components or procedures related to the SF and RW management are carried out. The QA program is subjected to review and assessment by EEAE.

The centralized interim storage facility of NCSR D has a quality assurance program in place, while the management system is under development.

According to RPR, medical laboratories, including radiotherapy and nuclear medicine laboratories (potential RW producers) are required to have quality assurance programs, the content of which is approved and regularly inspected by EEAE.

## Financial and human resources

According to article 7.5 and 13.1 of PD-122/2013 as amended by PD-91/2017, the licensee is required to ensure adequate financial resources and scientific and technical support needed for safe and secure SF and RW management, as well as sufficient number of suitably qualified and trained staff. Furthermore, the licensee is required to establish and implement a program of lifelong education and training for the employees engaged in tasks related to safety, radiation protection and emergency response.

Article 15.5 of PD-122/2013 as amended by PD-91/2017 provides that the SF and RW producer bears the associated management costs. The SF and RW producer, with graded approach, is required to have the necessary financial resources and skilled workforce required for the safe processing, conditioning, transport, storage or clearance.

## H. Expertise and skills (Article 8)

PD-122/2013 as amended by PD-91/2017 provides requirements and arrangements for the education and training for staff involved in SF and RW management.

During the last three-year reporting period, important training and R & D have taken place.

EEAE and NCSR D participate in the European Joint Program on Radioactive Waste Management EURAD and specifically in its WP9 “Waste management routes in Europe from cradle to grave (ROUTES)” and in its extension for small inventory member states. Specifically, EEAE and NCSR D participate in the following tasks of ROUTES:

- Task 2 - Identify challenging wastes to be collaboratively tackled within EURAD. Mapping and shared understanding at EU level of practical issues on waste management routes;
- Task 3 - Description and comparison of radwaste characterization approaches;
- Task 4 – Identification of WAC used in EU Member-States for different disposal alternatives in order to inform development of WAC in countries without WAC/facilities;
- Task 5 - RWM solutions for small amounts of wastes;
- Task 6 – Shared solutions in European countries.

Scientific and technical staff of organizations involved in RW management participates in actions of the International Atomic Energy Agency (IAEA) and EU research & development projects on the management of RW and RM. It is particularly encouraged the participation

in programs aimed at exploring common waste management solutions (shared regional solutions).

In the current period, the ongoing programs are:

- RER/9/143 "Enhancing Radioactive Waste Management Capabilities" (IAEA Technical Cooperation program, TC);
- RER/9/146 "Enhancing Capacities in Member States for the Planning and Implementation of Decommissioning Projects" (IAEA Technical Cooperation program, TC);
- INT/9/182 "Sustaining Cradle-to-Grave Control of Radioactive Sources" (IAEA Technical Cooperation program, TC);
- INT/9/183 "Regional Practical Training Course on Planning and Implementation of Nuclear Facility Decommissioning and Remediation of Radioactively" (IAEA Technical Cooperation program, TC).

In recent past the following program was carried out, as well

- RER/9/138 "Enhancing Capacities in the Member States for Management of Decommissioning Projects" (IAEA Technical Cooperation program, TC).

## I. Financial resources (Article 9)

### Cost estimation of the NatPro

The NatPro includes thirteen (13) actions grouped in two (2) main objectives, as presented in tables A and B of section K of this report.

The cost estimation of the NatPro actions is based and considers the following

#### 1. Objective A: Actions A3, A4, A5 and A6: Final management of disused RS

The cost for the final management of disused RS (e.g. export for recycling) and other RM is borne by the owners / producers (polluter pays principle). For exceptional cases where the owner / producer cannot be identified (e.g. orphan RS, or RS and RM detected in scrap metal, RS and RM from emergencies or illicit trafficking) the cost will be covered by the independent deposit fund of EEAE. The occurrence of such exceptional cases is very rare (from no-one case to very few cases per year), and almost never concerns category 1 or 2 sources that require high recycling costs.

#### 2. Objective A: Actions A7 and A8: Export of nuclear material

The cost of exporting nuclear material, namely fresh fuel of the NCSR D GRR-1 and fresh natural Uranium elements of the NTUA dismantled sub-critical assembly, and the export period cannot be determined precisely, given the uncertainties of the negotiation with the host institutions. The total cost is estimated to be around 400,000 Euros. This amount may be covered by utilizing the available reserves of the budgets of the material owners (NCSR D, NTUA).

#### 3. Objective B: Operation of the NRWIS interim storage facility and a future RW disposal facility

The implementation of Objective B entails, mainly, costs incurred by the operating costs (including staff) of the Radioactive Waste and Sources Management Facility of NCSR D (the NRWIS). The total cost is about 100,000 Euros per year and is undertaken from the credits of the state budget and the Special Account for Research Grants (ELKE) of NCSR D.



The MoU between EEAE and NCSR (Action B1) will entail obligations for the NRWIS related to the role and operational objectives of EEPADRA, as described in the legislation. The estimated running costs are approximately 40,000 Euros per year and will be covered by the credits of the ELKE of EEAE.

The costs for the actions regarding the legislation overview and development (Actions B2 and B3) concern expenses for hosting expert missions (accommodation and travel expenses) or possible expenses of consultants / researchers. These costs are estimated to be marginal and will be borne by the budget of each stakeholder at the time they will be incurred.

A preliminary analysis of the cost of a possible expansion of the Radioactive Waste and Sources Management Facility of NCSR to a disposal facility (Action B4) has been conducted, based on the recommendations of Organization for Economic Co-operation and Development (OECD), as described in the publication: "Low Level Radioactive Waste Repositories - A Cost Analysis, Nuclear Energy Agency (NEA), Organization for Economic Co-operation and Development (OECD), 1999". Assuming a safety factor of 50% for the estimated volume of waste to be disposed and an additional contingency of 30%, the estimated cost is about 1,000,000 Euros.

In case of the establishment of a disposal facility in a new site (Action B5), the cost for the investigations and the environmental and geological studies to determine a new location for the facility is estimated at 2,000,000 Euros, at the minimum. These costs are beyond the scope of the 2<sup>nd</sup> version of the NatPro because they exceed the current timeframe of the Medium Term Fiscal Strategy Program (MTEF).

## Financial plans

According to article 9 of PD-122/2013 all bodies, competent or engaged in activities related to SF and RW management, ensure the availability of sufficient financial resources, as needed for the implementation of the NatPro.

The Minister ensures the development and implementation of the financial plan for the SF and RW management, including disposal (article 7, par. 1 of PD-122/2013 as amended by PD-91/2017).

One of EEDRA duties is the preparation of financial plan and proposing funding sources for the implementation of the NatPro for SF and RW management.

The Minister shall ensure the implementation of the financing plan, which will not necessarily draw on the state budget but will be oriented in raising resources through, as indicative, projects, structural funds, recovery of the deposit fund, etc.

The SF and RW producers bears the associated management costs.

An independent deposit fund with separate code has been created in EEAE Special Account for Research Grants (ELKE) to cover financial needs of the NatPro. The amount of 1,000,000 Euros has been credited to this fund, by transfer from the available reserve of ELKE of EEAE, pursuant to par. 3 of article 45 of Law 4310/2014. The relevant Decision of EEAE was taken during the 255<sup>th</sup> meeting of the Board of EEAE on 27.07.2018, agenda item 2c.

Contributions by the state (government) budget are also made. Indicatively, the state budget of 2019 covered an amount of 450,000 Euros from the code AΛE 2420989001 (under EEAE) and an amount of 1.058.000 Euros from the code AΛE 2310802001 (under the General Secretariat of Research and Innovation – subvention to the NCSR) for the financing of the repatriation to the USA of the irradiated nuclear (spent) fuel of the GRR-1 research reactor. At the same time, however, an intensive effort is being made to find financial resources outside the state budget. Indicatively, in June 2021, the government included in the plans of the Recovery and Resilience Facility (RRF) the funding of an



investment of 5.7 million Euros entitled "Strengthening national infrastructures for the management of radioactive waste and radiological emergency response". Part of this investment concerns the management of radioactive waste in the country (allocated budget 3.65 million Euros over the period 2021-2025).

## J. Transparency (Article 10)

According to article 10.1 of PD-122/2013 the Minister and, as applicable, other competent bodies take the necessary steps so that the necessary information on the management of SF and RW are made available to workers and the general public.

Article 15.7 of PD-122/2013 as amended by PD-91/2017 states that the bodies in charge (i.e. the Minister, EEAE, EEDRA, the license holder, the RW producer) are required to provide the public with the necessary information and the possibility to participate effectively in the decision-making process concerning the management of SF & RW in accordance with national law and international obligations, provided this does not endanger public security.

Pursuant to Law 4310/2014, one of EEAE's competencies is to provide sufficient information to the general public and workers regarding its areas of responsibility [article 43, par. 4(g)].

In addition, EEAE inspection reports, EEAE Safety Evaluation Reports (SER) and the licenses for the GRR-1 research reactor and the interim storage facility of NCSR D are made publicly available via the EEAE web site.

Actions have been taken to improve communication with the public and transparency including, inter alia:

- stakeholders and information meetings on the European Regulatory Framework (BSS, nuclear safety and radioactive waste directives);
- promotion of safety culture through sharing lessons learned from radiological events: EEAE systematically disseminates findings and lessons learned from radiological incidents/accidents by posting them at EEAE website;
- public electronic consultation of the national regulatory framework for the safe management of spent fuel and radioactive waste;
- open data policy. By applying Law no. 4305/2014 (Government Gazette Folio no 237/A/2014), providing for the public disposition and further use of public documents, information and data, within the framework of integrating the provisions of European Directive 2013/37/EU, EEAE recorded all documents and data at its disposal and issued a related decision.

Finally, EEAE website is designed in such a way to facilitate the interested parties familiarize themselves easily with the licensing procedure and system, the templates to be used, the reports to be submitted and the relevant information. In general, EEAE website is a useful tool for public information and includes: data from the telemetric monitoring stations; data on medical radiation laboratories and reports, such as annual activity reports, radiological incidents reports, external evaluation reports (e.g. IRRS mission report), reports submitted to IAEA (CNS, Joint Convention), licensing documents for GRR-1 etc.

## K. Implementation of the national program (Articles 11 and 12)

### General on NatPro progress

The National Program (NatPro) covers all types, streams and management phases of the RW that fall under the jurisdiction of the Greek state, from their production to their disposal.

According to article 11 of PD-122/2013, the drafting of the initial (first) NatPro has been assigned to EEAE. At least every three years, EEAE proceeds with the subsequent updates of the NatPro, after the consent of the National Committee for Radioactive Waste Management (EEDRA). The respective draft of the NatPro is submitted to the Minister for approval. Following the NatPro approval and its publication as a ministerial decision, the NatPro becomes enforceable and notified to stakeholders, in order to harmonize the plans and actions for the management of the RW they possess. The NatPro is also notified to the European Commission by EEAE.

In 2020, the second version of the national program for the management of spent fuel and radioactive waste was published as Joint Ministerial Decision (MD-4317/2020). The revision was necessary to accommodate the experience gained during the implementation of the 1<sup>st</sup> NatPro and to consider the EEDRA recommendations and all recent developments and work being conducted by the EEDRA, EEDRA working groups and EEAE on the RW management. Examples of scientific or technical developments that led to the relevant changes in the NatPro are: the formulation of the most appropriate option and technical solution / option for the RW disposal facility; the need for exporting RS for recycling in order to reduce the RW disposal facility demands; the investigation for the development of criteria for candidate sites to host a RW disposal facility; the overview of national legislation on the waste management (radioactive, dangerous or urban); estimation of costs for different disposal options and facilities.

The most significant changes introduced to the second version compared to the 1<sup>st</sup> (initial) NatPro concern the milestones and timeframes, the updated of the RW inventory and financial arrangements for the RW management. It is anticipated that this revised NatPro would facilitate the implementation and monitoring of the national program in a more realistic and effective manner.

This second version of the NatPro concerns the period 2020-2023. The next NatPro version is expected to include the experience gained in the current 3 year period as well as conclusions of the self-assessment and the international peer review "ARTEMIS" which, following an invitation from the country and positive acceptance by the International Atomic Energy Agency (IAEA), is scheduled to take place in 2023.

The second version of the NatPro has the consent and endorsement of EEDRA on its basic principles, as decided at the 4th EEDRA plenary meeting of 03.07.2020 and was approved in its entirety by the EEAE Board at the 269<sup>th</sup> meeting on 15.07.2020.

For the implementation of the national policy, the actions of the NatPro are grouped in the following two specific objectives, which are inextricably linked to the principles of national policy:

**Objective A:** Recycling of sealed radioactive sources (RS) and radioactive material (RM).

Based on a national survey and the database of EEAE, five (5) disused RS of cat. 1, seven (7) of cat.2 and sixty-one (61) of cat. 3 are kept at facilities countrywide waiting for final management. In addition, cat. 4 and 5 disused sources, the fresh (non-irradiated) fuel from the GRR-1 and the fresh natural Uranium elements from the NTUA sub-critical assembly are waiting for final management. The 1<sup>st</sup> objective refers to the export for recycling of these disused RS and RM in order not to become RW. For implementing this objective, eight (8) actions with respective timeframes and responsibilities have been included to the NatPro as presented in the following table.

**Objective B:** Operation of the NRWIS interim storage facility and a future RW disposal facility.

NCSR D operates the NRWIS facility for the interim storage and management of RW. Within objective B of the NatPro a Memorandum of Understanding (MoU) between EEAE and NCSR D is considered to specify the responsibilities, duties, collaboration and joint activities for the RW management, pertaining the discrete roles of regulator and operator. Objective B also considers the investigation of the expansion of the NRWIS to a disposal facility. In case this is not found possible the establishment of a disposal facility in a new site will be sought. For implementing this objective, five (5) actions with respective timeframes and responsibilities have been included to the NatPro as presented in the following table.

**Objective A:** Recycling of sealed radioactive sources (RS) and radioactive material (RM).

#Milestone	Action	Responsibility	Timeframe	Action status as in June 2021
A1	Informing the RS owners about the recycling procedures of the disused RS they possess	EEAE	12/2020	Completed
A2	Drafting a protocol for the withdrawal of disused RS and other radioactive materials aiming their export for recycling in authorized recycling and management facilities	EEAE, disused RS owners	6/2021	EEAE has informed the RS owners and waits the delivery of their action plans and schedules.
A3	Removal of 40% of the Category 1 and 2 disused RS	Disused RS owners	6/2022	Completed: 4 out of 5 cat. 1 disused RS were exported for recycling and 1 cat. 2 RS is being re-used.
A4	Removal of Category 1 and 2 disused RS	Disused RS owners	6/2023	In progress
A5	Removal of Category 3 disused RS	Disused RS owners	12/2023	In progress
A6	Investigation to find a solution for the export of category 4 and 5 disused RS	EEDRA	12/2023	In progress
A7	Export of the remaining quantity of fresh (non-irradiated) nuclear fuel of NCSR "Demokritos"	NCSR	6/2021	The export (to Canada) is expected to be completed soon.
A8	Investigation to find a solution for the repatriation of the natural uranium elements (fresh) of the dismantled NTUA sub-critical research assembly.	NTUA and EEAE	6/2022	In progress

**Objective B:** Operation of the NRWIS interim storage facility and a future RW disposal facility

#Milestone	Action	Responsibility	Timeframe	Action status as in June 2021
B1	Memorandum of Understanding (MoU) between EEAE and NCSR D	EEAE and NCSR D	12/2020	Completed
B2	Overview of national legislation on the environmental permitting system and site of a radioactive waste disposal facility	EEDRA	6/2021	In progress
B3	Specialization of the regulatory framework for the licensing of RW management and disposal facilities (issuance of a joint ministerial decision based on the article 16 of PD 122/2013 as amended by PD 91/2017), including the period after the closure of the disposal facility	EEAE and Ministry of Development	3/2022	In progress. The first draft has been already prepared.
B4	Decision on the expansion of the operation of the NCSR D RW and RM interim storage facility to a RW disposal facility	Disused RS owners	6/2023	In progress. The conduction of a feasibility study and a preliminary environmental impact study has been approved by EEDRA and the EEAE Board of Directors and assigned to a group of experts of the NTUA. The reports are expected to be completed in April 2022.
B5	Finalization of data analysis related to (any) disposal facility: Environmental assessment strategy; Environmental impact study; Safety analysis report; Precise financing plan; Facility control and monitoring of environmental radioactivity for the post-closure period	EEDAR (and NCSR D in case of positive decision of B4 action	12/2023	Not started, yet.

## L. Peer reviews and self-assessments (Article 14.3)

### ARTEMIS mission

A self-assessment of the regulatory framework and the implementer's actions is going to take place in 2022 and the beginning of 2023. The self-assessment will be based on IAEA's questionnaire prepared for ARTEMIS mission. The mission has been invited to Greece in order to obtain an independent expert opinion and advice on radioactive waste and spent nuclear fuel management, decommissioning and remediation. The mission is scheduled for 2023. It is anticipated that ARTEMIS mission will help in:

- improving the NRWIS management facility performance;
- assessing the current strategy for the disposal facility establishment and strengthening credibility of decision-making processes from expert technical and program perspectives;
- enhancing safety, optimize operations and reduce costs;
- improving transparency and stakeholder confidence, including with the general public;
- drawing up the next version of the NatPro, for the period after 2023.

### IRRS mission

At the request of the Government of Greece, an IAEA Integrated Regulatory Review Service (IRRS) Follow-up mission was conducted in EEAE from 20 to 24 November 2017. The purpose of the IRRS Follow-up mission was to review Greece's progress against the recommendations and suggestions identified in the initial IRRS mission (20 to 30 May 2012).

Overall, the IRRS team concluded that Greece, through EEAE, has been responsive to each recommendation and suggestion made in 2012, and continues to place appropriate focus on implementing a framework that provides for effective protection of public health and safety. 26 out of 28 recommendations and 9 out of 10 suggestions identified in 2012 have been closed. More specifically, in the areas relevant to the RW management, the IRRS team deduced that since 2012, positive steps have been taken to:

- Update EEAE's legal and regulatory framework to bring into compliance with the latest IAEA safety standard;
- Develop and implement an integrated management system in EEAE and foster safety culture;
- Clearly assign responsibility for radiation safety including for the safe management of spent fuel and radioactive waste; and setting out the obligations and responsibilities of the license holder and the prime responsibility for safety;
- Develop a compliance assurance program for transport of radioactive material and strengthen the capacity for review and approval of package design by validation of the original certificate;
- Enhance the national regulatory framework for the management of radioactive waste and decommissioning.

Conversely, the IRRS team concluded that even if the IAEA classification scheme is generally applied in regulatory oversight, it has not been incorporated yet into its regulatory system. Therefore, the IRRS team considered that the relevant suggestion made in 2012 is still open.



## **M. Future plans to improve safe and responsible management of RW**

- The export of 40% of category 1 to 3 disused sources for recycling.
- Decision making whether the construction of a disposal facility should be considered at a new site or be based on the extension of the existing storage facility. In either case the combination of engineered near surface disposal with surface trench disposal shall be used

## ANNEX: INVENTORY of Radioactive Waste and Material (Status February 2021)

Research center (NCSR-D)								
	Interim Storage		GRR1		Expected RW after decommissioning GRR1		Total NCSR-D	
	m <sup>3</sup>	MBq	m <sup>3</sup>	MBq	m <sup>3</sup>	MBq	m <sup>3</sup>	MBq
VLLW	12,8	26			14,44	*	27,24	26
LLW	8	245	0,02	0,3	0,46	*	8,48	245,3
ILW	0,01	100000 <sup>c</sup>			0,92	700000 <sup>b</sup>	0,93	<sup>b</sup>
Legacy (objects in 100 drums)	20	1000 <sup>c</sup>					20	1000
Legacy (objects in 50 drums)			10	1000 <sup>c</sup>			10	1000
Legacy (cemented sludge in 50 drums)	10	50 <sup>c</sup>					10	50
VLLW (Liquid-Sludges)			26	570	0,6	*	26,6	570
Graphite Waste					5,6	*	5,6	*
Contaminated Soil with Pu	0,3	*					0,3	*
Contaminated plates with Pu			0,01	*			0,01	*
Contaminated objects (maintenance, house-keeping)			1	50 <sup>c</sup>			1	50
Consumer Products (lightning rods)	0,4	8000 <sup>d</sup>					0,4	8000
Consumer Products (smoke detectors)	0,2	405 <sup>d</sup>					0,2	405
Consumer Products (Vehicle Instr., Lamps, depU blocks)	0,5	500 <sup>d</sup>					0,5	500
<b>TOTAL NCSR</b>	<b>52,21</b>	<b>10226</b>	<b>37,03</b>	<b>1620,3</b>	<b>22,02</b>		<b>111,26</b>	<b>11846,3</b>
Notes:	* to be defined							
	<sup>b</sup> coarse estimate of significant uncertainty - decommissioning plan under development							
	<sup>c</sup> based on external dose surveys - characterization pending							
	<sup>d</sup> assuming typical item activities - registration in progress							
Facilities								
							m <sup>3</sup>	MBq
Contaminated Ash							75	<10000
Objects contaminated with NORM							100	<2500
Consumer Products (lightning rods) #1							1,6	27000
Consumer Products (lightning rods) #2							0,3	1300
Consumer Products (Vehicle Instr., Lamps)							1	500
Disused sources DSRS								
	Interim storage of NCSR-D	Facilities						
	Number of DSRS							
Category1		3						
Category2	1	1						
Category3	56	4						
Category4	15	57						
Category5	312	210						
<b>TOTAL</b>	<b>384</b>	<b>275</b>						