GREEK NATIONAL REPORT
under the
CONVENTION ON NUCLEAR SAFETY

Athens, August 2022

GREEK ATOMIC ENERGY COMMISSION

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A. Introduction

Greece has signed the Convention on Nuclear Safety, which entered into force in 1997 by parliamentary ratification. Greece participated in the previous review meetings of the contracting parties.

Greece has no nuclear power plants and no intention to build any in the foreseeable future. A nuclear research reactor exists (licensed for extended shutdown), as well as two sub-critical assemblies for research and educational purposes (one fully dismantled and one in operation).

In Greece, the focus on activities considered by the Convention on Nuclear Safety is on the consequences of nuclear accidents in nuclear power plants of third countries. Therefore, the reporting obligations are limited to those of Articles 7, 8 and 16 of the Convention on Nuclear Safety. However, information is provided under other articles of the Convention for some other non-nuclear power facilities and activities existing in Greece. The report follows the Guidelines regarding National Reports under the Convention on Nuclear Safety (INFCIRC/572/Rev.6, IAEA, 19th January 2018). The information provided in the report responds also to the two challenges identified by the Special Rapporteur at the 7th Review Meeting about the transposition and implementation of the European Basic Safety Standards (Directive 2013/59/Euratom) into the Greek framework and the update of the Emergency Preparedness and Response System, including the hazard assessment and protection strategies.

Greece has established and implemented laws and regulations on radiological protection and nuclear safety, in conformity with IAEA Safety Standards, the Euratom Treaty and European Directives. Mechanisms and structures are in place in order to face and cope with nuclear and radiological emergencies occurring on or outside the national territory.

In view of potential high risks emanating from nuclear installations, the country attaches great importance to international and European efforts towards nuclear safety and security issues. In this respect, Greece has undertaken activities with IAEA (education and training, exchange of information, peer review missions), as well as with other countries through bilateral agreements on early notification and warning schemes.

B. Summary

Greece has no nuclear power installations and no intention to build any in the foreseeable future. The existing research reactor and two sub-critical assemblies are not defined as nuclear installations by the Convention. As such, according to the Guidelines regarding National Report under the Convention on Nuclear Safety, reporting only on Articles 7, 8 and 16 is applicable for Greece. However, similarly with the previous reports, information on other activities is provided by seek of completeness and transparency.

The Greek Atomic Energy Commission (EEAE) is the competent regulatory body, responsible for radiological protection and nuclear safety.

Greece attaches great importance to nuclear safety and security. This is mainly reflected in intense international and European co-operation in the fields of education and training, sharing information and technical collaboration.

Developments since the last review meeting are summarized as follows:

- The Greek Radiation Protection Regulations (RPR) have been amended in order to comply with the Euratom Basic Safety Standards Directive (2013/59/Euratom) and to take into account the regulatory experience gained the last 20 years as well as the findings of the international peer reviews.
- A detailed assessment of potential emergency exposure situations and associated protection strategies has been completed, based on the GSR Part 7 methodology.
- The IRRS follow up mission was successfully completed in 2017. 26 out of 28 recommendations and 9 out of 10 suggestions identified in 2012 have been closed. With the view to continuously improve the safe management of radioactive waste, Greece has invited an Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS mission) to be held in September 2023.
- EEAE launched an institutional project entitled "Assessment of the national system for protection against ionizing and non-ionizing radiation – awareness-raising actions" (code name "AVRA") aiming at establishing a systematic approach for the overall assessment of the radiation protection system and raising awareness on radiation among the members of the public and specific target groups. Another objective of the project was the detailed study and evaluation of the situation in terms of radiological safety at national level by establishing, monitoring, and calculating appropriate performance indicators for different activities with radiation sources designed and implemented to raise awareness and inform both the public and the professionals in main radiation protection issues. The project was completed in 2021.
- Finally, it is noted that the Greek government has included in the plans of the Recovery and Resilience Facility (RRF) the funding of an investment of 5.7 million Euros, for the period 2021-2025, regarding the strengthening of the national infrastructures for the management of radioactive waste and radiological emergency response.

Regarding the challenges identified in the previous CNS Review Meeting, these are presented below, along with description of the actions taken:

<u>Transpose and implement the new European Basic Safety Standards (Directive 2013/59/Euratom) into the Greek framework</u>

The national regulatory framework has been amended implementing the graded approach. The updated RPR consist of: a presidential decree (PD 101/2018) which is the main legislative document that provides the regulatory framework for conducting activities related to ionizing radiation; three ministerial decisions dealing with the notification and authorization procedures, the assignment of responsibilities for the implementation of strategies for the management of existing exposure situations and the establishment of the national action plan addressing long-term risks from radon exposures; several EEAE decisions providing technical rules to control or

regulate specific tasks and activities; regulatory guidance which is a set of recommendations designed to assist individuals and relevant parties in complying with the legal requirements.

Update the Emergency Preparedness and Response System, including the hazard assessment and protection strategies (optimization)

In 2019, a detailed assessment of the potential emergency exposure situations with the relevant protection strategies has been completed, based on the GSR Part 7 methodology. The document with this first assessment has been approved by EEAE Board and the General Secretariat for Civil Protection (GSCP) and is used for the update of existing or preparation of new emergency response plans ("Special Response Plans in Case of a Radiological or Nuclear Emergency", referred to as "ESARPEA"). The majority of ESARPEA have been drafted and entered into force.

C. Reporting article by article

According to the Convention obligations, Greece, as a non-nuclear country, should report for Articles 7, 8 and 16. Therefore, detailed reporting is provided for these Articles. Moreover, as in our previous reports, some information is provided in relation to other Articles of the Convention.

Article 6: Existing nuclear installations

"Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shut-down may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact."

Greece has no nuclear installations as defined in Article 2 of the Convention on Nuclear Safety and has no intention to build any in the near future. Nuclear energy is not included in electricity production programme for the foreseeable future.

Information on the research reactor and other non-nuclear-power activities is provided for completeness in the followings.

Greek Research Reactor (GRR-1)

The GRR-1 is situated on the premises of the National Centre for Scientific Research (NCSR) "Demokritos". The reactor is out of operation. All used HEU fuel elements were returned to USA in 2005, following the terms of fuel purchase agreement between the U.S. Department of Energy and the Greek Government. Moreover, all used LEU fuel elements have been repatriated to USA since February 2019. The current license granted to GRR-1 for extended shutdown has been renewed in 2019 and is due to October 2024. The fresh fuel is envisaged to be exported by the end of 2022.

Sub critical assemblies

- The subcritical assembly at the National Technical University of Athens is dismantled (fuel is under secure in-situ storage);
- A subcritical assembly exists at the Aristotle University of Thessaloniki used for educational purposes.

Ionizing radiation installations

Other installations with ionizing radiation activities in Greece include:

- medical facilities, such as teletherapy, brachytherapy, diagnostic radiology and nuclear medicine centers;
- facilities operating in research centers and university departments, including an 11 MeV Tandem accelerator;
- industrial facilities using ionizing radiation devices and radiation sources. Among them, cyclotrons for the generation of medical radioisotopes and one irradiation facility for sterilization purposes;
- an interim radioactive waste storage facility.

Article 7: Legislative and regulatory framework

Article 7.1: "Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations."

Considerable effort has been devoted during the last years in extending and improving the legislative and regulatory framework. This effort has led to an important update of the legislative

system, including the transposition of the European Basic Safety Standards Directive (2019/59/Euratom).

The Greek legislative and regulatory framework for nuclear safety and radiation protection is listed below.

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 not to implement a nuclear power programme to generate nuclear electricity. 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;
- Ministerial Decision No. P/112/305/2012, Basic requirements – principles of nuclear safety and regulatory supervision of nuclear research reactors, Government Gazette Folio No. 2877/B/26.10.2012;
- Ministerial Decision No. 91175/2017, Amendment of Decision No. P/112/305/2012 (B 2877 / 26.10.2012) "Basic requirements – principles of nuclear safety and regulatory supervision of nuclear research reactors" transposition of the Council Directive 2014/87/ Euratom of 8 July-2014 amending Directive 2009/71/Euratom of 25 June 2009, Government Gazette Folio No. 1991/B/09.06.2017.
- Ministerial Decision No. 84631/2020, Amendment of Decision No. P/112/305/2012 (B 2877 / 26.10.2012) "Basic requirements – principles of nuclear safety and regulatory supervision of nuclear research reactors" transposition of the Council Directive 2014/87/ Euratom of 8 July-2014 amending Directive 2009/71/Euratom of 25 June 2009, as amended by the Ministerial Decision No. 91175/2017. Government Gazette Folio No. 3389/B/13.08.2020.

Implementation of the International obligations

- Law No. 1636/1986, Ratification of 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. 2480/1997, Ratification of the Nuclear Safety Convention, Government Gazette Folio No. 70/A/14.05.1997;
- 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. 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, 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; (amended in 2022)
- 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 exposure situations

In order to ensure that account is taken of the fact that emergencies may occur inside and outside the Greek territory an emergency management system has been established that is described in the following legislative documents (in chronological order):

- Law No. 3013/2002, Upgrade of the General Secretariat for Civil Protection, Government Gazette Folio No. 102/A/1.5.2002;
- 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;
- 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).

Other relevant legislation

- 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;
- Ministerial Decision No. P/112/1057/2016, 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 (amended in 2019).

Radioactive waste

- 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;
- 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 PD No. 122/2013;
- 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.

Legislation in progress

- Presidential Decree for the internal organization of EEAE (approved by the State Council in 2019, in the final process of approval).

Article 7.2: "The legislative and regulatory framework shall provide for:

i. the establishment of applicable national safety requirements and regulations;

ii. a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a license;

iii. a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licenses;

iv. the enforcement of applicable regulations and of the terms of licenses, including suspension, modification or revocation."

The PD No 60 (see Article 7.1) provides for the general legislative, regulatory and organizational framework for nuclear safety of nuclear installations, allocates generic responsibilities to the regulatory body (EEAE) and the license holder and defines generic nuclear safety principles. Following PD 60, the Ministerial Decision (MD) P/112/305 was issued to provide for more specific nuclear safety requirements and principles and regulatory control for research reactors in compliance with the IAEA NS-R-4 "Safety of Research Reactors: safety requirements", Vienna, IAEA, 2005. This MD was amended by the MD No. 91175/2017 for the transposition of the Directive 2014/87/Euratom (Nuclear Safety Directive). Safety requirements are specified in chapter 2 of the MD P/112/30, amended by MD No. 91175/2017 for all life stages of research reactors related to:

- license holder responsibility,
- safety management,
- evaluation and verification of safety,
- radiation protection (with reference to the RPR),
- siting evaluation,
- design and construction,
- commissioning, operation,
- maintenance modification and utilization,
- extended shutdown,
- decommissioning and
- waste management.

In Article 4.1a of PD No 60 it is stated that EEAE is responsible for the licensing for nuclear installations and for the prohibition of operation without a license. The licensing procedure for research reactors is described in chapter 3, Articles 14 through 21 of the MD P/112/305, as amended by MD No. 91175/2017 following the different life stages of a research reactor (construction, commissioning, operation, decommissioning, modifications, and extended shutdown). Construction and decommissioning licenses are issued by the relevant Minister, after EEAE agreement. Commissioning, operation and extended shutdown licenses are issued by EEAE. The existing GRR-1 is covered by transitional provisions in chapter 4, Article 24. After an application by the owner, EEAE granted an extended shutdown license for the GRR-1 in 2014, according to the requirements of Article 17.1 of MD P/112/305, which was renewed in 2019 and is due to 2024. In case the authorized party decides the re-activation of the refurbishment project and the re-operation of the reactor, a licensing procedure similar to that of construction of a new reactor shall be followed (Articles 24.3 and 17.2 of MD P/112/305), including assessment of all nuclear safety aspects and approval of the works for the refurbishment. Fuel loading in the reactor core is allowed only after the refurbishment or reconstruction works licensing and approval of the commissioning program.

Inspections by EEAE are performed, announced or unannounced, and the findings are documented. In case of non-compliance with safety requirements or the terms of the license, EEAE has the authority to proceed to modification, suspension or revocation of the license. The Law no. 4310/2014 provides EEAE for reinforced inspections and enforcement functions, including imposing administrative sanctions. Based on EEAE inspection programme and the current state of extended shutdown of GRR-1 the frequency of inspections is set to once per year.

Other radiation protection requirements, including dose limits for public and occupational exposure, are provided in the RPR according to the European Basic Safety Standards Directive 2013/59/Euratom, transposed to Greek legislation with the PD 101/2018.

Article 8: Regulatory Body

"1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfill its assigned responsibilities.

2. Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy."

The regulatory body in Greece is the Greek Atomic Energy commission (EEAE). An entity named EEAE was initially established by an Act in 1954 ("Atonic Energy Act"). EEAE has been re-established as competent radiation safety authority in 1987 by the Law 1733/1987. An important milestone in the timeline of the regulatory body itself was brought in 2014. With the provisions in Law 4310/2014 (Government Gazette Folio No. 258/A/08.12.2014) the earlier framework (Law 1733/1987) has been replaced by the current operation framework of EEAE. The basic elements accommodated in the updated framework are summarized below:

- EEAE is explicitly designated as the regulatory competent authority for the control, the regulation and the supervision of the sector of nuclear energy, nuclear technology, radiological and nuclear safety and radiation protection, and its competences are codified in a consolidated text, by completing, extending and clarifying the older provisions;
- EEAE acquires complete administrative and financial effective independence, keeps its scientific character and is given the form of public entity;
- EEAE as regulatory authority is henceforth the licensing administrative authority;
- inspection procedures and inspectors' role are reinforced significantly;
- legislative enforcement means are provided by specifying administrative and penal sanctions;
- EEAE is provided with the power to conduct hearings and public consultations, and to issue a number of regulations;
- provisions for transparency enhancement, accountability and avoidance of conflict of interests are included;
- provisions ensuring organization's resources and sustainable financial independence are foreseen;
- EEAE can cooperate with research/academic institutions on educational matters.

The current EEAE operation regime is in line with the international and European requirements for radiation protection and nuclear safety regulatory authorities, enhances the effective independent and regulation of this field and addresses the relevant IRRS mission findings.

EEAE functions also include:

- participation in emergency preparedness and response;
- operation of a personnel dosimetry service in the country;
- environmental radioactivity monitoring, including operation of the telemetric environmental radioactivity monitoring network and laboratory radioactivity measurements;
- calibration of ionizing radiation instruments;
- non-ionizing radiation measurements.

Education and training (E&T)

EEAE provides education and training on radiation protection issues since 1960. Nowadays, it has a range of E&T activities, in participating in post-graduate and continuing E&T activities at national and international level. These activities are supported by EEAE scientific personnel and the available infrastructure. At national level, a variety of training courses covering issues, such as

occupational radiation protection, transport and emergency response, are organized in the framework of national programme established and implemented since 2013. For all its training activities EEAE implements a management system certified according to ISO 29990:2010.

At regional and international level, EEAE is the IAEA Regional Training Centre (RTC) in the English language for Europe and Central Asia on Radiation, Transport and Waste Safety, as well as on nuclear security. After the successful completion of the IAEA Education and Training Appraisal (EduTA) mission to Greece in 2008, a Long Term Agreement (LTA) between the Government of Greece and the IAEA, to support EEAE as RTC for radiation, transport and waste safety was signed in July 2011. The LTA was ratified by the Greek Parliament in October 2012 (Law 4085/2012). In 2015, EEAE requested and received a follow up EduTA mission, which re-confirmed the high quality in the education and training provided.

Since 2003, EEAE hosts, the Postgraduate Educational Course on Radiation Protection and the Safety of Radiation Sources co-organized and co-funded by IAEA.

EEAE participates also in research and development programmes, such as the projects under IAEA Technical Cooperation Programme and the EC Framework Programmes. EEAE personnel present a significant number of publications in scientific journals and conferences.

Public information

EEAE holds the responsibility of providing information to the general public and the media regarding its fields of competence. Public information related activities, such as organization of events, dissemination of information material, are systematically implemented.

EEAE policy regarding information dissemination is based on the principles of transparency and openness towards interested parties and the general public. EEAE has both formal and informal mechanisms of communication, including meetings, web-based information and public consultation, as appropriate. As a public entity, EEAE is obliged to follow official procedures of communication with all authorized parties and the general public. Since the last review meeting, actions have been taken to improve communication with the public and transparency. Within this framework a survey was carried-out to depict both public and professionals' opinion in the fields of radiation protection and safety culture, respectively. The public attitudes and knowledge about radiation and risk perception was explored through a nationwide quantitative study. Elements of the societal perception of radiation along with attitudes towards popular uses of radiation, nuclear energy and radioactive waste management were investigated. On average, the Greek people seem to be highly concerned about radiation; this concern is mainly related to the electromagnetic fields, the radioactive waste management, as well as the potential risk from nuclear accidents abroad. The findings also indicate reduced trust to the competent authorities, as well as a quest for more information. Moreover, the survey results showed that safety comes up as a self-evident prerequisite and as a well-established parameter in the workplace. Regarding EEAE role, feelings of confidence and reliability, but also feelings of dependence, were recorded. The survey is seen as a strategic tool for developing information and training actions. The main results of the public opinion survey are published at: https://eeae.gr/en/news/announcements/perceptions,-attitudes-and-knowledge-of-the-public-opinion-in-greece-about-radiation-national-survey-results. The survey is part of the institutional project entitled "Assessment of the national system for protection against ionizing and non-ionizing radiation – awareness-raising actions" (code name "AVRA").

Organization, human and financial resources, management systems

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 State Council (June 2019) and is in the final stage of governmental approval. The proposed new organization chart is shown in Figure 1. Following IRRS mission findings, the new internal structure provides for the operational separation between its regulatory functions and scientific and technical services. EEAE is governed by a seven-member Board.

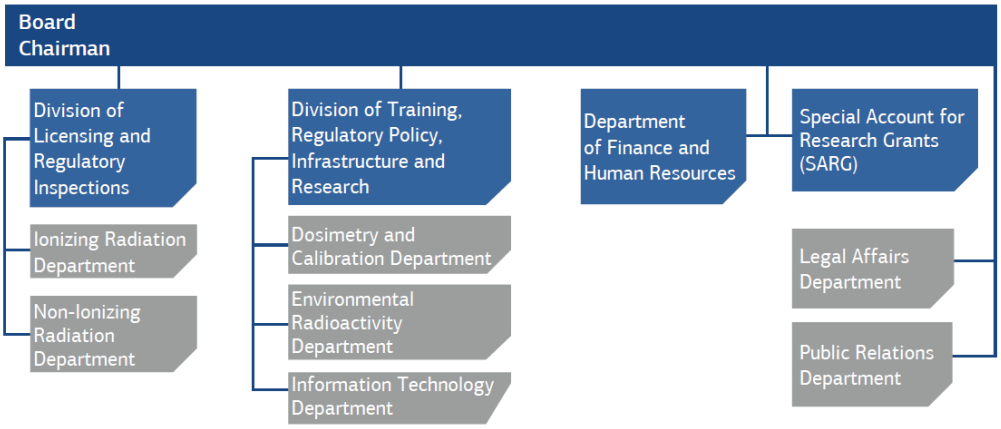

Figure 1. Organizational chart of EEAE

EEAE employs a sufficient number of qualified and competent staff (76) to carry out its tasks. Most of EEAE personnel hold a degree of high level education and dispose specialized scientific expertise (M.Sc. and/or Ph.D.). They participate in several working groups and committees at national, European or international level. Their continuous training, the participation in EEAE E&T activities and the participation in scientific networks is encouraged in order to gain the knowledge and experience required to successfully fulfill their tasks.

EEAE financial resources come from the public budget, as well as licensing fees, externally funded projects and the provision of technical services. The accounts and fiscal reports of EEAE are subject to the control of the Audit Council. These data and fiscal reports, together with the budget estimation for the coming year, are published on EEAE website and submitted to the President of the Hellenic Parliament and the relevant Minister as part of the Annual Report.

EEAE implements an integrated management system (IMS) as provided in MD No 84631/2020; in 2013 it was certified in accordance with the requirements of ISO 9001:2008 standard, and later in 2016 with the requirements of ISO 9001:2015. The IMS incorporates all functions and accredited activities of EEAE. The integrated management system was designed to respond to the IRRS findings, in line with IAEA safety standards and more specifically to GSR Part 2. Specific attention was given to:

- leadership for safety demonstrated by the executive team (Chairman and Heads of units);
- establishment of a system of Key Performance Indicators (KPIs) to ensure safety and monitoring the achievement of strategic goals;
- the policy document consistent with the vision, mission and principles of EEAE and dissemination of this document to all EEAE staff;
- ensuring interaction with interested parties, especially during the drafting of the new RPR;
- the application of the graded approach in the main functions of the regulatory body (i) the legislative framework, (ii) the regulatory process (notifications and authorization of practices), (iii) inspections and (iv) review and assessment of the documents submitted.

Article 9: Responsibility of the license holder

"Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant license and shall take the appropriate steps to ensure that each such license holder meets its responsibility."

For nuclear installations and research reactors, the prime responsibility is assigned explicitly to the license holder (PD No 60, Article 6.1).

Article 6.2 of PD No 60 requires that license holders, under the regulatory control of EEAE, assess and verify regularly, and continuously improve the nuclear safety or their installations in a systematic and verifiable manner. More specific requirements in relation to research reactors are provided in article 5 of MD P/112/305, as amended by MD No 91175/2017, according to which, the license holders are obliged to assess the safety of the reactor in a systematic way before the

construction and commissioning and also before significant modifications or changes in utilization. The assessment shall be documented appropriately in safety documents and shall include all stages of the reactor lifetime. The assessment and the relevant documentation shall be updated periodically (in case of the nuclear research reactor every 10 years at least) and whenever it is required, taking into account the experience from the operation and the technological and scientific developments in the field. License holders shall verify the safety of the reactor by safety analysis, surveillance and inspections. The required safety documents shall be submitted to and reviewed by EEAE, as part of the licensing procedure. EEAE performs inspections to assure the compliance with the regulation provisions.

For the current stage of extended shutdown it is provided that the license holder shall implement an adequate program to maintain the safety of the reactor and the physical protection of the facility and the safety of the nuclear fuel and other radioactive materials (Article 11 of MD P/112/305).

For any other radiation involving activity in Greece, specific responsibilities of the license holder are provided in the RPR.

Article 10: Priority to safety

"Each Contracting Party shall take the appropriate steps to ensure that all organizations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety."

The national legislation gives due priority to safety in relation to radiation involving activities, including research reactors, and nuclear security issues.

Research reactor

For the research reactor, relevant requirements are explicitly provided in the MD P/112/305, as amended by the MD No 91175/2017 and MD No 84631/2020. Safety culture is strengthened through, inter alia, a management system that prioritizes nuclear safety at all levels of staff, including managers, and promotes the effective implementation of the principles concerned. More specifically, the following are applicable in all stages of the research reactor lifetime (Article 4 of the MD P/112/305):

- policy for the management of research reactors that gives to safety high priority and promotes safety culture, through the appropriate organizational structure;
- management system based on leadership and culture for safety;
- internal safety committee, independent from the reactor manager;
- lifelong learning of the reactor staff with duties connected to safety;
- due consideration of human factors;
- defense in depth concept applied to the design of the research reactor and
- systematic operator safety self-assessment.

Nuclear Security

In 2004, EEAE in collaboration with the IAEA and the U.S. Department of Energy upgraded the physical protection systems of selected radiation facilities in the country including:

- the nuclear research reactor GRR-1;
- medical installations – radiotherapy units and blood irradiators and
- industrial installations using high activity sources.

For the prevention of illicit trafficking of radioactive or nuclear materials, EEAE, in collaboration with IAEA, the U.S. Department of Energy and the Greek Customs Department, equipped the country's entrance points with radioactivity detectors. In particular, fixed systems for radioactivity detection are installed at the major customs offices and portable radioactivity detectors have been distributed to the custom offices in the country.

In the same context, radioactivity detectors – pagers and portable spectrometers have been distributed to border police and Coast Guard.

The customs local detection systems have been networked; the central server includes a database with alarms triggered on any custom system.

Article 11: Financial and human resources

"1. Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.

2. Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety-related activities in or for each nuclear installation, throughout its life."

The requirement regarding the responsibility of license holders of nuclear installations to maintain adequate human and financial resources is provided in Article 6.5 of PD 60. This requirement is further addressed in MD P/112/305 for research reactors, where it is required that adequate number of trained and competent personnel shall be involved at all stages of the reactor lifetime (Article 4.3). In Article 4.4, it is stated that adequate financial resources shall also be provided for the lifetime of the reactor. Information regarding the staff and the arrangements for ensuring the required financial resources shall be included in the license application for all stages of a reactor lifetime, as provided in MD P/112/305.

Regarding the other relevant activities, the RPR provide for the requirement of properly educated and trained staff. The mechanisms and the criteria for the recognition and approval of experts engaged in facilities and activities is addressed in the new RPR (PD 101/2018 and MD 45872/2019). The provision of training and information shall be repeated at appropriate intervals and documented.

Article 12: Human Factors

"Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation."

Article 7 of the PD 60/2012 provides for the maintenance and further development of expertise and skills of the staff having responsibilities relating to the nuclear safety of nuclear installations. Moreover, due consideration of human factors is a safety requirement provided in the MD P/112/305 for research reactors, including provisions for the extended shutdown phase.

Article 13: Quality Assurance

"Each Contracting Party shall take the appropriate steps to ensure that quality assurance programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation."

Based on MD P/112/305 an appropriate quality assurance programme shall be established and implemented for all activities carried out in nuclear installations. EEAE performs regulatory inspections to ensure the compliance of these requirements with the current legislative framework.

Article 14: Assessment and verification of safety

"Each Contracting Party shall take the appropriate steps to ensure that:

i. comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body;

ii. verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions."

According to Article 3 of MD P/112/305 license holders of research reactor have the prime responsibility, throughout the lifetime of the reactor for ensuring, implementing and complying with the safety requirements, in line with the national and European legislation and the applicable IAEA safety standards. In addition, Article 5.3 provides that the license holders shall verify the

safety of the reactor through analysis, surveillance and inspections, in order to maintain compliance with the design, the safety analysis, the operational limits and conditions and the safety requirements. The application for the licensing of a research reactor, in all stages of its lifetime, shall include an appropriate, applicable safety analysis report, through which, as provided in Article 19.1, the license holder shall demonstrate the safety of the installation, in line with the safety requirements. The content of the safety analysis report is based on IAEA safety standards for research reactors and is defined in Article 19 of MD P/112/305 and shall be commensurate with the actual hazards posed in the particular state of the reactor.

EEAE, as stated in Article 23.1 of MD P/112/305, is the competent authority for assessing the safety of research reactors. Whenever EEAE deems, it has the authority to require any information and clarification, including information concerning contractors. No restriction is allowed regarding the provision of information to EEAE (Article 23.4). In addition, EEAE has the authority to require from the license holder improvements, modifications or to take measures, in case of non-compliance with the safety requirements or the terms of the license (Article 23.5).

In particular for the current state (extended shutdown) of GRR-1, an applicable safety analysis is required to be submitted to EEAE (Article 17 of MD P/112/305). NCSR "Demokritos" has submitted the updated to the present state chapters "Radiation Protection" and "Conduct of operation", as well as the current surveillance and maintenance program and the physical protection program.

Inspections are also carried out to the reactor by IAEA and Euratom inspectors within the framework of safeguards and in compliance with Articles 35, 36 of the Euratom Treaty.

Article 15: Radiation Protection

"Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits."

The new national legislation on radiation protection implements the European BSS Directive 2013/59/Euratom. General radiation protection requirements, including dose limits for the public and occupational exposure are provided.

The current national dose limits in terms of effective dose are 1 mSv/year for the public and 20 mSv/year for the occupational exposure (or 100 mSv in five consecutive years). Dose limits for the equivalent dose at specific organs are provided in the regulations, as well.

Article 16: Emergency Preparedness

"1. Each Contracting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency.

For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the regulatory body.

2. Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.

3. Contracting Parties which do not have a nuclear installation on their territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear installation in the vicinity, shall take the appropriate steps for the preparation and testing of emergency plans for their territory that cover the activities to be carried out in the event of such an emergency."

In the current legislative framework it is explicitly stated that all authorized parties, including GRR-1, shall establish an emergency management system (commensurate with the practices carried out in the facilities), including internal emergency response plans (at facility level with links, where appropriate, to the external plan) and shall report to EEAE any abnormal event immediately.

Regarding the emergency management system at national level, Greece can be affected in the event of a radiological emergency at a nuclear installation of a third country. Such situations are covered

by Annex "R" of the National Plan for Civil Protection "Xenokratis". According to the emergency management system, EEAE is responsible for:

- the assessment of the potential emergency exposure situations (performed on a five year basis) and its submission to the General Secretariat of Civil Protection (GSCP) for approval as part of the country's emergency management system;
- the assessment of the situation and proposal of measures to higher level officials as part of the emergency response;
- the assessment of the effectiveness of strategies and implemented actions and proposals for adjusting them as appropriate to the prevailing situation as part of the emergency response;
- the necessary operational preparedness of the telemetric network for radioactivity measurement in the country;
- the activation and coordination of the measurement campaign around the country, in which various laboratories countrywide participate in case of an emergency (the so-called "Network of Collaborating Laboratories").

EEAE also is the contact point for receiving and communicating information to the IAEA and EC emergency-response systems (USIE and ECURIE respectively), organizes emergency response drills and participates in international exercises. EEAE participates in the IAEA "Incident reporting system for research reactors" and the "Incidents and trafficking database" (ITDB). In addition, EEAE has concluded provisions on a bilateral basis for early notification with Bulgaria and Romania.

In the following, more information is provided about the current national emergency system which is currently under update following the promulgation of Presidential Decree 101/2018, the main Act transposing the new European BSS Directive 2013/59/Euratom in the national legislation.

Current national emergency plans

According to PD 101/2018 EEAE shall be competent for the assessment of potential emergencies in or out of Greece, which may entail radiological risk for the country. In 2019, a detailed assessment of nuclear and radiation related threads has been completed (referred to as "ADKEA"), based on the GSR Part 7 methodology. This first assessment of potential emergencies has been approved by EEAE Board and submitted to the GSCP to be used for the update of existing or preparation of new emergency response plans ("Special Response Plans in Case of a Radiological or Nuclear Emergency", referred to as "ESARPEA"). CBRN consists one specific case of ESARPEA. The preparation and approval of ESARPEA is coordinated by the GSCP. Up to now the majority of these specific plans have been drafted and approved by the GSCP. GSPR in cooperation with EEAE and other competent bodies, organize information meetings and exercises. The structure of the GCPP according to the new framework is shown in Figure 2.

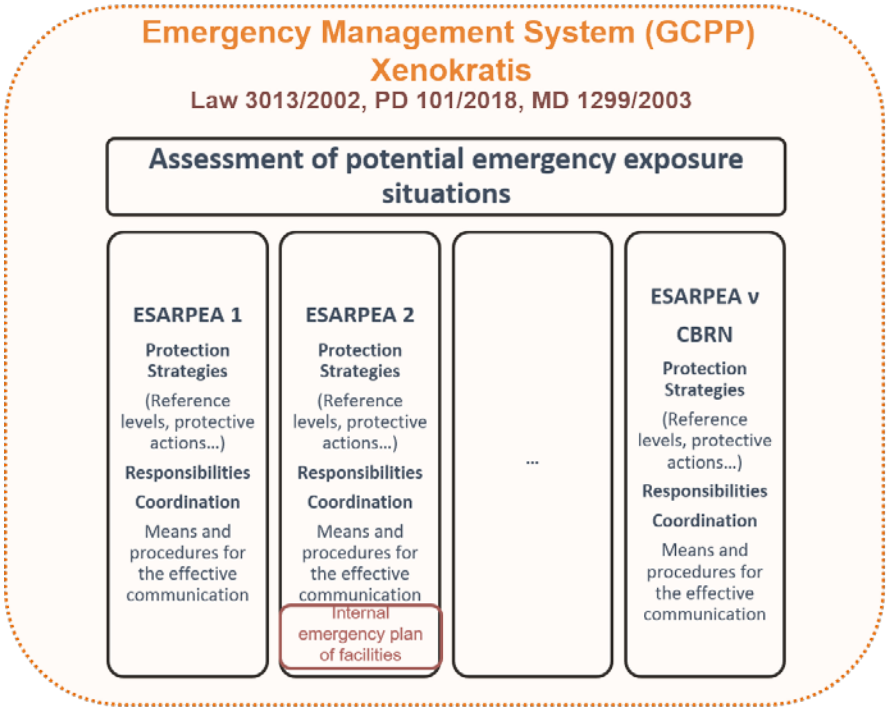

Figure 2. The structure of the General civil protection plan for emergency exposure situations as laid down in PD 101/2018

EEAE role and preparation for the emergency exposure situations

EEAE plays a key role in implementing the plans regarding nuclear or radiological emergencies. In order to cope with its statutory duties in the field of emergency planning and response, EEAE has established an internal emergency plan, part of its integrated management system, as shown in figure 3. The majority of EEAE personnel participate in the internal emergency plan. Special teams (such as radiation protection team, communication team, etc.) have been formed, the members of which have specific duties.

EEAE has adequate equipment devoted to emergency planning including, a mobile laboratory, measuring and detection systems, protective equipment, specialized vehicle with the possibility of carrying and stabilizing shielded radioactive sources and computer codes for atmospheric dispersion and transport of radioactivity (US NOAA HYSPLIT, JRODOS, HOTSPOT).

Moreover, EEAE runs specialized laboratory infrastructure consisting of: the environmental radioactivity laboratory for performing measurements of environmental samples, the telemetric network for on-line monitoring of the environmental radioactivity all over the country, the individual monitoring laboratory for external and internal radiation. EEAE coordinates a network of collaborating laboratories belonging to Universities and Research Centers throughout the country ("Collaborating Laboratories") and collaborates with national, European and international organizations (e.g. emergency response systems, databases, networks).

Information activities in case of an emergency

EEAE is responsible to provide information through appropriate channels, such as GSCP, to the public in relation to a radiation emergency.

More specifically, EEAE is responsible that the public is given the required information about ionizing radiation, the risks involved and the measures generally taken in emergency situations, and about the health protection measures applicable to those members likely to be affected in the event of an emergency.

The procedures for informing these members of the public that are actually affected by an emergency situation, the steps to be taken and the appropriate health protection measures

applicable, as well as the related competences of the involved bodies are specified in the ESARPEA response plans.

Depending on the demand for information from the public, EEAE adopts a range of tools to ensure broad dissemination and transparency. These include press releases and individual responses to media, press conferences and interviews. Real time environmental radioactivity monitoring data (telemetric network) are available through EEAE website during emergencies. A link to EURDEP is also provided.

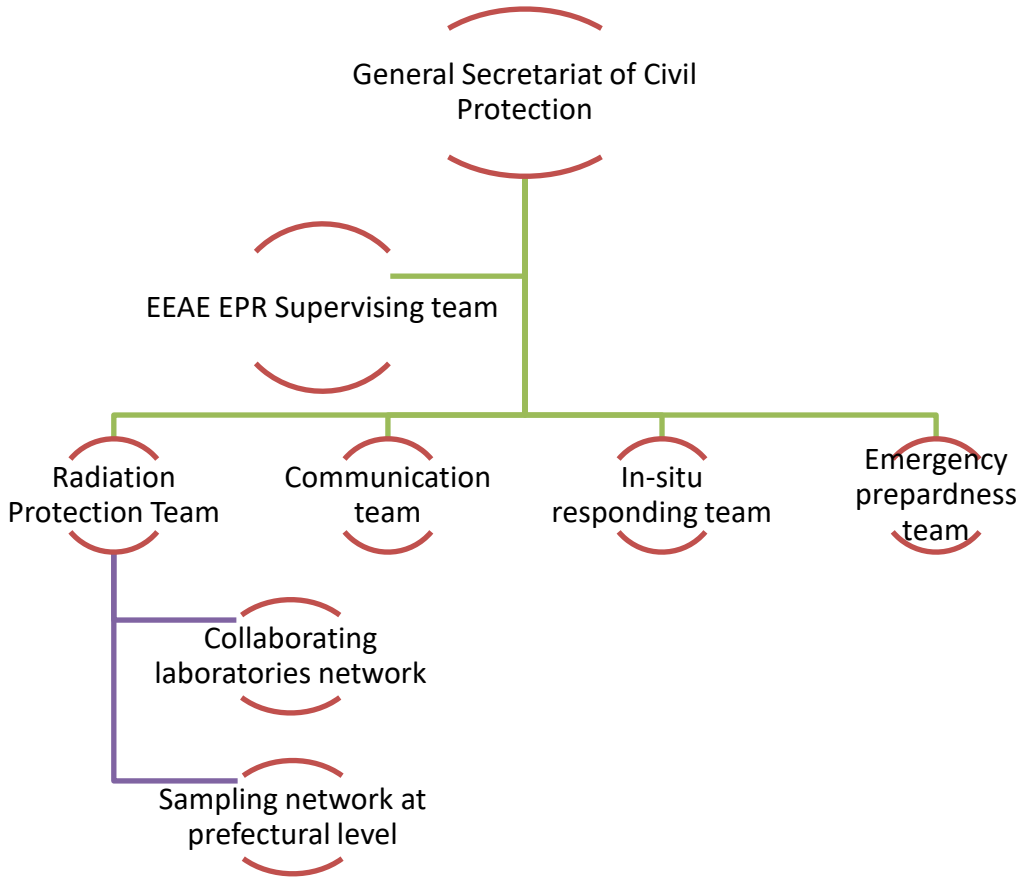

Figure 3: organizational structure of EEAE internal emergency plan and its link to GSCP

D. Activities, achievements and concerns regarding the improvement of safety since last meeting

Since the last review meeting the following important developments have been achieved or are in progress:

- The RPR have been recently amended in order to comply with the Euratom Basic Safety Standards Directive (2013/59/Euratom), as well as to take into account the regulatory experience gained the last 20 years and the findings of international peer reviews (e.g. IRRS mission 2012, follow-up IRRS mission 2017) of the national regulatory framework.
- A graded approach scheme has been implemented in the structure of the legislation framework itself. The new framework has a pyramid structure consisting of: one presidential decree (at the top level), three ministerial decisions specifying procedures and responsibilities set in the presidential decree, EEAE regulatory acts (EEAE decisions) providing legally binding technical rules and, finally, EEAE regulatory guidance which is a set of recommendations designed to assist individuals and relevant parties in complying with the legal requirements.
- A detailed assessment of the potential emergency exposure situations and the relevant protection strategies has been completed, based on the GSR Part 7 methodology. This first assessment (referred to as "ADKEA") has been approved by EEAE Board and GSCP to be used for the update of existing or preparation of new emergency response plans ("Special Response Plans in Case of a Radiological or Nuclear Emergency", referred to as "ESARPEA").
- The IRRS follow up mission was successfully completed in 2017. 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 ARTEMIS mission has been invited 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).
- The update of the "Arrangement between the Greek Atomic Energy Commission (EEAE) and the United States Nuclear Regulatory Commission (NRC) for the exchange of technical information and cooperation in nuclear safety matters" was signed in Vienna, in September 2019, on the margins of the 62nd General Conference of IAEA.
- EEAE completed an institutional project entitled "Assessment of the national system for protection against ionizing and non-ionizing radiation – awareness-raising actions" (code name "AVRA"). The AVRA project resulted at (a) establishing a systematic approach for the overall assessment of the radiation protection system and the impact of regulatory framework on the economy and society; and (b) raising awareness among the public and specific target groups on radiation, mainly through pioneering education and information actions.
- As part of "AVRA" project, EEAE conducted for first time a survey of both public and professionals opinion in the field of radiation protection. The "terra incognita" of public attitudes and knowledge about radiation and risk perception was explored through a nationwide quantitative study. Elements of the societal perception of radiation along with attitudes towards popular uses of radiation, nuclear energy and radioactive waste management were investigated. In parallel, the aspects of safety culture among professionals was explored by means of qualitative survey based on in-depth personal interviews.

E. Changes since the previous National Report

Since the submission of the last National report (August 2019) the following updated information is highlighted:

- The Ministerial Decision 84631/2020 has been entered into force, which amends the ministerial decision regarding the basic requirements – principles of nuclear safety and regulatory supervision of nuclear research reactors. The issues addressed in this latest amendment are related to (i) safety culture of the regulatory body and the authorized parties as part of the integrated management system and (ii) the procedures of self-assessment and peer reviews, including topical peer reviews, when a research reactor with thermal power of 1MW or more exists in Greece.
- The programme for the management of the radioactive waste has been updated in October 2020.
- The majority of Special Response Plans in Case of a Radiological or Nuclear Emergency, as they have been indicated by the methodology for the assessment of nuclear and radiation related threads, have been prepared and approved by the GSCP.
- A new project will be launched as a result of the Greek government's commitment to include in the plans of the Recovery and Resilience Facility the funding of the upgrade of two safety related infrastructures for the management of radioactive waste and radiological emergency response.
- The remaining fresh LEU fuel elements of the GGR-1 are scheduled to be exported soon in Canada (to the McMaster University research reactor).

F. Experience with response to Covid-19 pandemic

EEAE initiated a number of measures to fulfill safely its regulatory functions during the pandemic. More specifically:

- The authorization process was practically not affected. Priority was given to hospital and health care units that needed special attention due to the overload caused by the pandemic. EEAE personnel could work remotely and, therefore, the review and assessment of all the relevant documentation for the authorization of facilities and activities was performed without no delays or other safety issues.
- Regarding the inspection process: The inspection plan was adjusted since no inspection was performed in hospital and health care units. However, EEAE developed and implemented a new procedure to inspect facilities and activities *remotely*. The procedure is now included in EEAE integrated management system.
- The communication process with the authorized parties was strengthened. EEAE had to answer many questions and give advice to personnel who had to work either remotely or under new challenging conditions.
- The pandemic, from the very beginning, raised questions of trust between the public and the competent authorities. We consider that EEAE has gained public trust through the continuous information provided to the public in every safety related case, even for the perceived risks, in combination with a raising awareness campaign which has already been mentioned in Article 8 (AVRA project).

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