NATIONAL REPORT OF GREECE
under the
"JOINT CONVENTION
ON THE SAFETY OF SPENT FUEL AND ON THE SAFETY OF
RADIOACTIVE WASTE MANAGEMENT"
2011

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SECTION A. INTRODUCTION

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 and entered into force on 16 March 2000.

The present report is the National Report of Greece for the 4th Review Meeting to the Convention, which will take place in 2012 at the IAEA in Vienna. The report has been prepared in accordance with the Guidelines regarding the Form and Structure of National Reports (IINFCIRC/604/Rev.1, 19 July 2006), established by the Contracting Parties under Article 29 of the Convention.

Greece has no nuclear power plants. Spent fuel management is therefore relevant only in connection with the operation of the unique research reactor GRR-1 at the National Centre of Scientific Research (NCSR) “Demokritos” and of two small subcritical assemblies. The policy and practice for spent fuel management for GRR-1 is to temporary store the fuel elements in dedicated storage facilities, awaiting transfer to USA jurisdiction, according to an agreement with the US Department of Energy for shipment until 2019. All future fuel purchases will be based on similar arrangements with foreign nuclear companies/organizations that will guarantee the return of spent fuel to the country of origin for storage or reprocessing. Since 2004, GRR-1 is under refurbishment and it has not been operated. Therefore, no spent fuel is presently stored on the site and only irradiated fuel that is planned to be re-used is under storage.

Radioactive waste in Greece originates from medicine, research and industry; waste with Naturally Occurring Radioactive Materials (NORM) results from some industrial activities as well. The management of radioactive waste is carried out on the site of origin. The national policy for the radioactive waste produced when un-sealed sources are used is on-site storage, decay and/or discharge. As it concerns the sealed sources, and since there is no national production, the back-end solution has been adopted.

The Joint Ministerial Decree 1014 (ΦΟΡ) 94, Official Gazette No 216/B/6-03-2001 “Radiation Protection Regulations” (RPR), published in 2001, is the national legislation concerning the civilian applications of ionizing radiation and implementing the IAEA BSS and Euratom Directives 96/29 and 97/43. In relation to the particular radioactive waste issue, since 1990, according to Greek legislation, the import license for radioactive sealed sources is granted by the regulatory authority, the Greek Atomic Energy Commission (GAEC), under the condition that the foreign supplier certifies to take back the source when it is used. Moreover, Greece has implemented the European Council Directive 2003/122 on the control of the high activity sealed radioactive sources and orphan sources (HASS) by issuing a Ministerial Decree. GAEC started in 2003 a programme, with the scope to return all the unused and orphan sealed sources to a foreign waste management facility for recycling; under this program, a project that dealt with the old legacy sources has been completed in September 2005.

Greece attaches the highest importance to international efforts to harmonize and increase all aspects of nuclear safety. In this respect, Greece has initiated projects and bilateral agreements with other countries and tries to participate and contribute to all relevant international and European activities, including review meetings of the Joint Convention on the Safety of the Spent Fuel Management and on the Safety of Radioactive Waste Management. Greece has asked for an IRRS mission (scheduled for May 2012), considering it as a unique opportunity to improve the regulatory framework, in terms both of the compliance with IAEA standards and of effectiveness.

SECTION B.
POLICIES AND PRACTICES

Article 32 Reporting, paragraph 1

(a) Spent fuel management policy

The spent fuel of the GRR-1 has been returned and will be returned in the future to the United States Department of Energy, according to an existing contract for shipment until 2019. This means that Greece has no obligations regarding the final disposal of spent fuel, with the minor exception for the fuel of two sub-critical assemblies.

(b) Spent fuel management practices

Spent fuel from the GRR-1 is stored on site until the return shipment to the United States. Shipment follows applicable transport and safeguards legislation.

Interim wet storage of spent fuel of GRR-1 takes place in the reactor pool and in a separate pool inside the reactor building. Spent fuel from the reactor has been returned to the United States in 1996 and 2005.

The fuel of the decommissioned sub-critical assembly of the National Technical University of Athens (NTUA) is under dry interim storage in NTUA premises, under the control and supervision of the Nuclear Technology Laboratory of NTUA. Preliminary actions have already been taken, in conjunction with IAEA, to explore the feasibility of the repatriation of the fuel to the country of origin.

There is no spent fuel from the second sub-critical assembly of the Aristotle University of Thessaloniki, as the facility is still used as a zero power assembly.

Storage of spent fuel follows applicable radiation protection and safeguards legislation. Regular inspections are performed by the regulatory authority and by Euratom and IAEA safeguards inspectors.

(c) Radioactive waste management policy

Radioactive waste in Greece originates from medicine, research and industry (including industries generating waste with NORM). Only low-level waste derives from these sources. For such waste, the national policy is on-site storage, decay and discharge. The management of radioactive waste is carried out on the site of origin. The producers of radioactive waste have to bear the full costs.

Greece supports the idea that sharing of disposal facilities in the context of an agreement between the countries, taking into account the conditions specified in the recently adopted European Council Directive 2011/70/Euratom is a beneficial, cost-effective and safe option, and believes that it consists a feasible option.

(d) Sealed radioactive sources

The case of sealed radioactive sources is discussed under Section J.

(e) Storage facilities

In light of the above described situation and arrangements, there are no plans to create a long-term storage or disposal facility. Short-term interim storage of radioactive sources and waste awaiting disposal is provided in facilities located at the NCSR "Demokritos", which however, in the light of the near future implementation of the EC Directive 2011/70/Euratom, shall be reconsidered in terms of the regulatory control.

(f) Regulatory aspects

Radioactive waste management follows the RPR specifications. Inspections are performed by the regulatory authority (GAEC) at least once every two years, in order to verify compliance with RPR. According to the 2010 data, the inspection programme covered 1428 facilities of the medical sector, 329 of the industrial and 223 of the research and education sector. That resulted to 664 inspections annually, about 10% of which were without prior notification.

Greek national authorities are responsible for the availability of technical infrastructure and equipment related to the treatment of radioactive waste.

(g) Radioactive waste management practices

For the waste produced in NCSR "Demokritos", on-site waste treatment includes a range of operations, such as waste segregation, characterization, conditioning, storage and discharge after verification of clearance.

Nuclear medicine and other research laboratories short lived waste, according to RPR provisions, are appropriately stored on site until decay and then released to the environment, to a waste disposal for non radioactive waste or to a waste treatment facility for infectious waste. Special retention tanks might be required in nuclear medicine laboratories using I-131. GAEC has issued an explanatory circular, complementary to the RPR, defining the methodology and criteria for the need to install retention tanks, which fully agrees with an IAEA relevant policy statement.

GAEC in collaboration with the NCSR "Demokritos" and the Ministry for the Environment started in 2003 and completed in 2005 an action aiming at the collection of unused radioactive sources in the country and their export to specialized facilities for recycling. The collection is a continuing effort and this action is going to be repeated when a significant number of non-used sources are collected again. Until their export for recycling, the sources remain in the interim storage facility built on the campus of NCSR "Demokritos".

GAEC has adopted the EC Radiation Protection 122 ("Practical use of the concepts of clearance and exemption" – Part II) and has issued an explanatory circular for this purpose. Industrial waste produced by NORM industries with radionuclide concentrations exceeding the exemption levels has been exported to a foreign country for recycling.

Criteria to categorize low and intermediate-level radioactive waste: Radioactive waste characterization in Greece follows the latest issued IAEA standards.

SECTION C.
SCOPE OF APPLICATION

Article 3 Scope of Application

(a) As mentioned before in Sections A and B, spent fuel management in Greece concerns only the GRR-1. All spent fuel of the GRR-1 has or will be returned to the United States. Regarding the fuel of NTUA sub-critical assembly, the feasibility of its repatriation to the country of origin is being explored in corporation with IAEA.

(b) Greek legislation declares waste that contains NORM as radioactive waste, only if the exposure to the general public exceeds legally binding limits when this material is released to the environment. The regulated activities inducing NORM waste include the agricultural applications of phosphogypsum, the decommissioning activities of abandoned industries, etc. NORM waste is considered in this report.

(c) Greece has not declared spent fuel or radioactive waste within military or defense programmes as spent fuel or radioactive waste for the purposes of the Convention.

According to Greek legislation, GAEC is the competent authority for the safety of radioactive waste management. Even if GAEC is not responsible for the radioactive waste from the military sector, it is handled by GAEC in the same way as described in this report, since this waste is covered by the legislative system described in Section E.

SECTION D.
INVENTORIES AND LISTS

Article 32 Reporting, paragraph 2

(a) Spent fuel management facilities

In Greece there are no spent fuel management facilities.

(b) Inventory of spent fuel

GRR-1 is not operating since 2004. All spent fuel produced by that time was exported to the US during 2005. The existing irradiated fuel assemblies are kept at the GRR-1 interim storage pool under Euratom safeguard provisions. The inventory of the irradiated assemblies is given in Section L (Table a). These elements will be re-used after completion of the reactor refurbishment program.

(c) Radioactive waste management facilities

The radioactive waste management facility at NCSR “Demokritos” includes:

1. Central retention tanks for aqueous waste
2. Sorting box for the segregation of solid waste
3. High force compactor
4. Equipment for cementation
5. Facilities for interim storage

Before waste discharge without restriction, the followings are taken into account:

1. The composition and the activity of the waste, provided by the users.
2. Independent measurements performed by the waste management personnel. In particular, the dose rate on the surface of the waste drum should be at the level of the background dose rate (the measurements are performed at a low background area), and the spectrum after a 30 min measurement with a portable NaI detector (Exploranium device) on contact to the drum should be comparable to the 30 min background spectrum. Then the drum is evacuated inside the segregation box and contamination measurements are performed with a surface contamination detector.

The radioactive waste management provisions for the research and medical sectors, included in Part 6 of the RPR, are:

1. Sealed sources after their useful life are returned to their manufacturer abroad.

2. Radioactive waste produced by the use of unsealed sources in solid and/or liquid form:

   - Solid waste is stored in dedicated shielded storage containers for decay, until they reach the unconditional clearance levels provided by the Radiation Protection Regulations, which are in accordance with the EC Report for Radiation Protection 122-Part 1.

   - Liquid waste is disposed through the laboratory's dedicated and labelled pipelines to the national sewage system, in accordance to the specific levels for unconditional clearance provided in the RPR.

(d) Inventory of radioactive waste

Excluding the spent and disused sealed sources, the most significant production of radioactive waste takes place in NCSR "Demokritos".

Table (b) in Section L shows the radioactive waste produced from GRR-1 refurbishment works in the period 2008 – 2010.

Table (c) in Section L shows the annual average quantities of radionuclides supplied at the NCSR "Demokritos" for the year 2010. These eventually show up as waste.

Table (d) in Section L shows the radionuclides used in nuclear medicine laboratories all over the country that result in the production of radioactive waste.

Table (e) in Section L shows the radionuclide activities in the primary resin waste. The radiological characterization of the resins was performed as part of the ongoing project for the characterization of the NCSR "Demokritos" legacy waste.

SECTION E.
LEGISLATIVE AND REGULATORY SYSTEM

Article 18 Implementing measures

Greece has fully implemented the Joint Convention on the Safety of Spent Fuel and on the Safety of Radioactive Waste Management.

Article 19 Legislative and Regulatory Framework

The laws and regulations relevant to this Convention are given below.

(a) Greece has no nuclear power programme. The legislative framework establishing a system of licensing with regard to nuclear installations exists since 1971:

- Decree Law No 854, Official Gazette No 54/A/18-03-1971
  "Terms to Establish and Operate Nuclear Installations"

- Presidential Decree No 610, Official Gazette No 130/A/23-08-1978
  "Establishing Terms and Procedures in Licensing P.P.C. to Construct a Nuclear Power Plant on a Specific Site or change of the Site."

(b) According to the existing legislation, the Greek Atomic Energy Commission is the regulatory body responsible for the implementation of the nuclear safety, waste management and radiation protection regulations.

- Decree Law No 1733 (Article 28), Official Gazette No 171/A/22-09-1987

  "Establishing the Greek Atomic Energy Commission"

- Law No 181, Official Gazette No 347/A/20-11-1974

  "Protection Against Ionizing Radiation"

- Joint Ministerial Order 1014 (ΦΟΡ) 94, Official Gazette No 216/B/6-03-2001

  "Radiation Protection Regulations"

- Ministerial Order No 2739, Official Gazette No 165/B/15-03-1994

  "Regulation on Informing the General Public about Health Protection Measures to be Applied and Steps to be Taken in the Event of a Radiological Emergency"

- Presidential Decree No 22, Official Gazette No 20/A/26-02-1997

  "Supervision and Control of Shipments of Radioactive Waste between Greece and the other Member States of the EU and Into and Out of the EU"

- Ministerial Order No 2344, Official Gazette No 212/A/11-10-1995.

  "Organization of Civil Protection".

- Law No 2824, Official Gazette No 90/A/16.03.2000

  "Ratification of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management".

- Ministerial Order No 10828 / EFA(1897), Official Gazette No 859/B/10-07-2006 "Control of the high activity sealed radioactive sources and orphan sources",

implementing the European Council Directive 2003/122 on the control of the high activity sealed radioactive sources and orphan sources (HASS).

- Presidential Decree No 22, Official Gazette No 20/A/26-02-1997 "Supervision and control of shipments of radioactive waste and spent fuel", implementing the European Council Directive 2006/117/Euratom of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel.

(c) The Greek legislative framework related to safeguards and non-proliferation is the following.

- Decree Law No 437, Official Gazette 49/A/26-02-1970
  "Ratification of the Non Proliferation Treaty Signed on the 1 July 1968"
- Safeguards Agreement between Greece and IEAE signed on 17-11-1972
- Law No 1636, Official Gazette No 106/A/18-07-1986
  "Ratification of the Physical Protection of Nuclear Material Treaty"
- Ministerial Order No 5408 /E3/2362/ Φ. NSG, Official Gazette No 730/B/21-09-1993
  "Control on Transfer of Nuclear Materials, Armament and Technologies Affecting National Defence and Security"
- Law No 2805, Official Gazette 50/A/3-3-2000, "Ratification of the Additional Protocol."

(d) Greece is in the final stage of the transposition of the European Council Directive 2009/71/Euratom, establishing a Community framework for the nuclear safety of nuclear installations.

(e) GAEC Circulars:

- "Clearance levels for NORM", 03.08.2006.
- "Release of patient excreta following nuclear medicine therapy", 30.11.2006

Article 20 Regulatory Body

The Greek Atomic Energy Commission (GAEC) was initially established by an Act in 1954. The organization has been re-established with a different mandate in 1987, according to which GAEC is an autonomous, decentralized, civil service supervised by the General Secretariat for Research and Technology under the Ministry of Education, Lifelong Learning and Religious Affairs and is responsible for matters of nuclear technology, radiation protection and nuclear safety in the country.

GAEC is governed by a seven member Board of Governors, appointed by the Minister of Education, Lifelong Learning and Religious Affairs. GAEC reports to the Greek Government, the European Commission and IAEA when required or according to the existing arrangements and obligations.

Its responsibilities (regulatory and inspection duties, education and research duties, radiological emergency) cover issues of nuclear energy and nuclear technology, as well as issues related to the protection of the public, workers and environment from ionizing radiation, as well as artificially produced non-ionizing radiation. Moreover, its participation in the "General Civil Protection Plan" entails responsibilities for the prevention, preparedness and response to radiological emergencies. GAEC also participates in the "National Emergency Plan for Nuclear, Radiological, Biological and Chemical Threats" (NRBC).

Protection of the public from ionizing and non-ionizing radiation is mainly accomplished by:

- environmental radioactivity monitoring (telemetric network and laboratory measurements),
- individual monitoring of all workers occupationally exposed to ionizing radiation,
- issuing licenses for the import, export, possession, use, transport and disposal of radioactive materials,
- performing radiation protection inspections in laboratories using or producing ionizing radiation,
- carrying out measurements of electric and magnetic fields in all kinds of facilities emitting low or high frequency electromagnetic radiation,
- examining the submitted technical electromagnetic emissions studies and the environmental impact studies,
- training activities,
- participating or coordinating research and development projects.

GAEC's staff consists of 70 persons (60% scientific, 15% technician, 25% administrative) and has:

- regulatory and inspection duties,
- education and research duties,
- special duties in case of radiological emergencies.

GAEC's scientific and technical personnel are of a high scientific level (M.Sc. and/or Ph.D.). They participate in several working groups and committees at a national, European or international level. Their contribution in European research projects and scientific networks, as well as their scientific work in GAEC produces a number of publications in international journals and presentations in conferences. These facts prove that GAEC's personnel are of high scientific level, being always well informed and up to date.

GAEC collaborates in a systematic manner with a lot of institutions in national, European and international level, in all fields of its competency.

GAEC's laboratories are unique in the country and are equipped with up-to date equipment.

GAEC's financial resources, adequately covering its needs, come from the public budget as well as from licensing fees and radiation protection services.

SECTION F.
OTHER GENERAL SAFETY PROVISIONS

Article 21 Responsibility of the license holder

According to the RPR any practice with ionizing radiation is not allowed without a license. The RPR describe the responsibilities of the license holder who is primarily responsible for the safe use, handling, storage, etc. of radioactive materials, radiation protection of workers and the environment, quality assurance, reporting, etc, as well as of any other person involved in the radiation protection of each practice.

The waste management concept and all relevant actions undertaken by a facility are evaluated as part of the licensing process. The licensee has to implement the RPR requirements in respect to waste management and to apply the needed quality assurance (QA) and quality controls (QC) programmes on these matters. Furthermore, the GAEC inspects at a regular basis the facility's waste management programme as well as the licensee responsibilities.

Article 22 Human and financial resources

RPR provide requirements for human resources of the licensee. The verification of the adequacy and the education and training of the personnel is a part of the licensing process.

For the import of sealed radioactive sources, the licensing imposes that full financial provisions are made by the licensee for waste management and the return of the sealed sources to the manufacturers. In case the collected funds are insufficient for the real costs of final disposal, the government will cover the difference (implementation of HASS).

The GRR-1 is owned and operated by the research centre NCSR "Demokritos", a governmental institution, under General Secretariat for Research and Technology, Ministry of Education, Lifelong Learning and Religious Affairs. The government assures the responsibility to cover by state funds any cost of its future decommissioning and post-closure remedial or rehabilitation actions.

Article 23 Quality assurance

The RPR include the concept of QA in all practices. The existence of a QA programme is obligatory for each facility and is subjected to the competent authority inspection and evaluation.

GAEC, through the radiation protection regulations, fully supports and encourages the activities related with QA / QC programs for all radiological installations. For example, GAEC laboratories have all been accredited by the Hellenic Accreditation System according to ELOT EN IEC/ISO17025 standard.

In addition, the Department of Licensing and Inspections has accredited in 2011 by the Hellenic Accreditation System for accreditation according to ELOT EN IEC/ISO17020 standard.

Article 24 Operational radiation protection

All activities with ionizing radiation in the country are performed in accordance with the RPR, which implement the IAEA BSS and Euratom Directives 96/29 and 97/43. All radiation protection measures for the public, the occupationally exposed workers, the medical patients and the environment, are subjected to GAEC inspection, control and evaluation.

For the activities within the scope of the Joint Convention (e.g. waste management facilities, interim storage, environmental radioactivity laboratory, etc), NCSR "Demokritos" and the GRR-1 apply their own radiation protection programme assured by the Health Physics Service, that is controlled by GAEC on a regular basis.

GAEC provides the individual monitoring of all occupationally exposed workers and keeps the national records. The workers are submitted to medical surveillance programme.

The liquid or air discharges are monitored by the licensee holders and surveyed by GAEC. Moreover, GAEC performs intercomparison and intercalibration exercises with the environmental monitoring, waste and research reactor measurement laboratories of the NCSR "Demokritos". The last (September 2005) inspection performed under the Euratom Article 35 has concluded that Greece is in full compliance with the requirements of Article 35 of the Euratom Treaty.

Article 25 Emergency preparedness

According to RPR, in each facility there is an internal emergency preparedness plan in case of a radiological or nuclear accident or event, which is subjected to GAEC inspection and evaluation.

According to its statutory role, GAEC is responsible for the coordination of the national environmental radioactivity monitoring programme. In this respect GAEC:

- operates a national telemetric network containing 24 stations for total gamma dose rate measurements and 3 stations for aerosol measurement,
- together with NCSR "Demokritos" performs air filter measurements from different locations in the country,
- together with NCSR "Demokritos" performs measurements in soil, water and food samples,
- coordinates a network of 9 collaborating research and University laboratories providing environmental radioactivity measurements, performs intercomparison exercises and harmonizes the measurement procedures.

The water reservoirs of the Greek capital are monitored on a monthly basis by GAEC.

According to its statutory role, GAEC is responsible for emergency preparedness, advises the Government on the measures and interventions necessary to protect the public and acts as contact point for receiving and communicating information to the emergency response systems.

Since its establishment, GAEC participates in the National Emergency Plan for Civil Protection "Xenokratis" (Ministerial Decree No 1299, Official Gazette of the Greek Government No 423B, 10.04.03, "Approval of the General Plan for Civil

Protection, under the Code Name Xenokratis"). In particular Annex "P" (Greek letter rho) of the GCPP concerns the response to an emergency situation from important and extensive radioactivity contamination due to radiological or nuclear accidents taking place inside or outside Greece and is designed to provide response to accidents involving the release or potential release of radioactive substances.

GAEC is the authority responsible for activating the GCPP Annex "P", while the overall management of the emergency response rests with increasing level of responsibility with the following three managing Committees:

- The Staff Office (SO): a three-member committee chaired by the President of the GAEC and supported by a properly staffed Information Group,
- the Scientific Committee (SC): a seven-member committee chaired by the President of GAEC, having as main task the assessment of the proposals submitted by the SO and the suggestion to the Ministerial Coordination Board the proper actions and counter measures for the situation in hand,
- the Ministerial Coordinator Board: is convened in emergency cases according to the provisions of the general emergency plan, and is chaired by the Minister of Development.

According to the emergency plan, the emergency situations arising from a wide spread radioactive contamination of the Greek territory, are classified as follows:

- normal level - level A,
- alert level - level B which is characterized by increased environmental radiation or radioactivity levels or when information is received for a nuclear accident through the ENATOM or ECURIE systems or through the countries with which Greece has signed bilateral agreement on early notification,
- alarm level - level C. In this level the emergency plan is fully activated and all governmental and other national authorities are ready to perform their duties according to the plan.

On the occasion of the Athens 2004 Olympic Games, the Athens 2004 Olympic Games Security Division developed the National Emergency Plan for Nuclear, Radiological, Biological and Chemical Threats. Nowadays this plan runs under the coordination of the General Secretariat for Civil Protection. GAEC was deeply involved in drafting and implementing the Nuclear/Radiological part of this plan and acts as the major counterpart of the General Secretariat for Civil Protection for those two factors (N/R).

In order to cope with the above, GAEC's emergency response system has been significantly upgraded with a new internal emergency plan, the necessary personnel and appropriate infrastructure.

GAEC's relevant infrastructure contains measuring and detection systems (detectors, surveys, dosimeters, contamination monitors, portable spectrometers, pagers, etc), protective equipment, an independent communication system, a mobile laboratory fully equipped with a series of detectors, spectrometers, protective equipment and a radiochemical laboratory, a specialized vehicle for collecting radioactive sources, a scientific library containing recent publications relevant to the nuclear and radiological safety and security, radiological

emergency computer codes (Lasair, Hotspot, Hysplit, etc) and detailed, step by step documentation for the procedures to be followed in case of an emergency.

In addition to the above, GEAC specialized laboratories (environmental radioactivity laboratory, telemetric network, individual monitoring laboratories, etc.) and the network of the collaborating laboratories assist in case of an emergency.

Staff training, emergency exercises intercalibration and intercomparison exercises are performed on a regular basis.

GAEC participates in International and European Emergency Response Systems and Data Bases (ECURIE, IAEA Illicit trafficking data base, ENATOM, etc).

Article 26 Decommissioning

Decommissioning of the GRR-1 is not considered for the foreseeable future. In the previous Safety Analysis Report (SAR) of the GRR-1 no decommissioning plan was provided. The regulatory and legislative framework is currently being updated in order to comply with the provisions of the EC Directive on the nuclear safety. The final draft of a Precedential Decree has been finalized and it is in the relevant Ministries for signature. According to this Directive and to a Ministerial Decree, which is currently being drafted, the safety assessment documents that needed to be submitted as part of the licensing of the operation of the GRR-1, shall cover the decommissioning plan. The GRR-1 has the qualified staff for this task. Since the GRR-1 research reactor is owned by a governmental institution, the government assures the responsibility to cover the cost of its future decommissioning.

Decommissioning of the waste management facility and the interim storage facility of the NCSR “Demokritos” is not foreseen for the near future. The preparation of such plans is in progress.

SECTION G.
SAFETY OF SPENT FUEL MANAGEMENT

Article 4 General safety requirements

As explained in Section B, Greece has only one research reactor (GRR-1) and has no plans for a nuclear power programme or for additional research reactors.

Spent fuel from GRR-1 has already been returned to the U.S. Department of Energy. Any new spent fuel will be returned by 2019. Therefore, Greece has only to take care of the on-site interim storage. The GRR-1 license and safety regulations cover the safety of the interim storage in the reactor pools.

Article 5 Existing facilities

NCSR “Demokritos” operates GRR-1, since July 1961. GRR-1 is an open-pool, light water moderated and cooled reactor, with a nominal power of 5MW (thermal). GRR-1 uses materials-testing reactor, MTR, plate-type fuel elements. Until the beginning of July 2004, GRR-1 used a mixed core including high (HEU 93%) and low (LEU 19.75%) enriched fuel elements. GRR-1 has been fully converted to LEU in 2006, whilst the existing 46 HEU spent fuel assemblies have been shipped to the USA (Savannah River Site) at the end of 2005. GRR-1 has a spent fuel interim wet storage pool with capacity of 57 assemblies inside the reactor building. Another 48 spent fuel assemblies may be stored inside the reactor pool. GRR-1 has not yet started operating under its new configuration as it is undergoing refurbishing.

Article 6-8 Siting of proposed facilities, Design and construction of facilities, Assessment of safety of facilities

It is not foreseen to design or construct new facilities.

Article 9 Operation of facilities

The interim fuel storage facility is within the GRR-1 building and operates under the responsibility of NCSR “Demokritos” and under the supervision of GAEC. This is an underground stainless-steel, 1.6m x 2.6m and 4m deep tank, offering 57 storage positions arranged in five groups. Cadmium sheets are properly positioned between storage positions to make any undue criticality impossible. The tank is filled with demineralised water. Recirculation of the water through a resin-type mixed-bed ion exchanger (4.5 m3/h capacity) via installed piping, keeps it in appropriate pH and conductivity levels, eliminating any corrosion hazard for the stored fuel elements. The tank is secured by steel covers.

Article 10 Disposal of spent fuel

All spent fuel from GRR-1 is to be transferred to USA jurisdiction, according to an agreement with the US Department of Energy for shipment until 2019. Fuel purchases beyond 2019 will be based on similar arrangements with foreign nuclear companies/organizations that will guarantee the return of spent fuel to the country of origin for storage or reprocessing.

SECTION H.
SAFETY OF RADIOACTIVE WASTE MANAGEMENT

Article 11 General safety requirements

Criticality and removal of residual heat is not a concern for the interim storage of NCSR “Demokritos”.

Management of radioactive waste, the provisions of which are included in the RPR, is based on the following general principles:

- Avoid the generation of radioactive waste or limit the waste generated to short half-life radionuclides.
- Provide for effective protection of individuals, society and the environment, taking into account the biological, chemical and other hazards.
- Take into account interdependencies between stages of radioactive waste management.

Article 12 Existing facilities and past practices

(a) Waste at NCSR “Demokritos”

The only category of radioactive waste that was solidified in Greece is sludge and evaporation concentrates. In the past, aqueous waste from the radionuclide production plant in NCSR “Demokritos”, was either released after monitoring or transferred to the waste treatment plant for concentration by evaporation, then solidified by addition of Portland cement and vermiculite in steel drums. The evaporator was of steam-heated type. The solidified waste drums are stored in the storage facility at NCSR “Demokritos”. Since the radioactive inventories at the time of solidification are known, the acceptability for disposal in a future repository can be assessed. This practice is no longer used today.

Radioistope production has been discontinued. Aqueous waste is collected in retention tanks, located close to the place where it is produced, then it is released after decay and monitoring.

In the current NCSR “Demokritos” waste management facility, there is a sorting box equipped with a ventilation system providing segregation of the solid waste, a high force compactor and a cementation device.

The segregation and characterization of radioactive waste enable selection of suitable treatment and conditioning techniques, as well as disposal methods. Characterization is carried out by representative sampling and measurement with gamma spectroscopy and/or by non destructive analysis techniques. In particular cases, low level alpha spectroscopy and liquid scintillation after radiochemical treatment can be used. The segregation and characterization of radioactive wastes in NCSR “Demokritos” are performed taking into consideration:

a. activity and radionuclides present;
b. half-life of radionuclides present;

c. physical and chemical form of the waste, such as:
   - solid (compactible, non-compactible);
   - liquid (aqueous and organic);
   - homogeneous or non-homogeneous (contain sludge or suspended solids);
d. non-radiological hazards (toxic, pathogenic, infectious, genotoxic, biological or pharmaceutical properties);
e. required storage activities.

This segregation and characterization approach has been sufficient for the relatively simple and straightforward cases dealt with in the past. The global effects from all steps are considered, taking into account any local and/or global optimization options and giving preference to solutions that do not foreclose future options if reasonable.

Treatment/conditioning techniques are the following:

1. Regeneration of the resins using NaOH and HCL solutions
2. Solidification in Portland cement with addition of vermiculite, which is now used for sludge
3. Placement in containers with cement shielding when is necessary.

The concentrated and solidified aqueous waste is kept in the interim storage facility of NCSR “Demokritos” under monitoring and control.

(b) Waste from medical applications and sealed sources

Since 1991, Greece has a well-established regulatory system for controlling waste from nuclear medicine labs, so that disposing such solid or liquid waste does no harm to the environment. The RPR, contain the following provisions:

Liquid:

- The disposal of liquid radioactive waste to the public drainage is permitted only if the maximum concentration in any part of it is less than 1GBq/m3.
- Under no circumstances the daily disposed quantity should exceed 18 MBq for in vitro labs, 37 MBq for in vivo diagnostic labs, and 110 MBq for in vivo diagnostic and therapeutic labs.
- H-3 and C-14 used as organic solvents in liquid scintillators can be disposed in quantities of less than 3 GBq and 0.3 GBq per day, respectively.

Solid:

- Solid radioactive waste is permitted to be disposed as ordinary waste if it does not contain reusable objects and its concentration is below the clearance levels for each radionuclide.
- Short-lived (half-life < 60 days) solid waste that cannot be disposed according to the regulations is stored in vaults inside the labs, under specific requirements provided by the RPR, until its radioactivity falls below the clearance levels. All the other solid waste such as used sealed sources is returned to its supplier abroad for recycling.

Article 13-15 Siting of proposed facilities, Design and construction of facilities, Assessment of safety of facilities

It is not foreseen to design or construct new facilities.

Article 16 Operation of facilities

The facilities operate under the responsibility of NCSR “Demokritos”. The operation of the facilities is subjected to the radiation protection requirements of RPR and the control of the effluents of the facilities is subjected to the Euratom Treaty Article 35 and 36 requirements.

Article 17 Institutional measures after closure

There are currently no plans for closure of the existing facilities.

SECTION I. TRANSBOUNDARY MOVEMENT

Article 27 Transboundary movement

The transboundary movement of the spent fuel shipped to the US is covered under the provisions of the agreement with the US Department of Energy.

The transboundary movement of radioactive waste is covered by the RPR, which takes into account the Council Directive 93/3/Euratom/3.2.1992 “On the supervision and Control of Shipment of Radioactive Waste between Member States and into and out of the Community”. Also, other safety standards (e.g. IAEA etc) are taken into account.

On the occasion of the Olympic Games Athens 2004, and to prevent that radioactive materials are smuggled into the country, GAEC in collaboration with the IAEA and the Greek Customs Office and under the US Second Line of Defense Programme, implemented state-of-the-art technology at borders to detect illicit trafficking of radioactive or nuclear materials. Specifically, 57 portal monitors and 456 pieces of handheld equipment were provided in 32 cargo and passenger entry-exit points of the country, covering 7 airports, 12 seaports, and 13 land-borders. The fixed systems contain gamma and neutrons detectors. The hand held equipment is used for the secondary control when fixed systems are installed or for the primary control in the smaller entry points. These sets of equipment are composed by radiation pagers indicating the presence of radiation, by gamma detectors in order to determine the radioactive source location and intensity and spectrometers specifying additionally the radionuclide.

SECTION J.
DISUSED SEALED SOURCES

Article 28 Disused Sealed Sources

According to national legislation enacted in 1990, in order to import a sealed radioactive source, the foreign supplier must make the commitment to take back the source when it is decommissioned. This is also provided by the implementation of the European Council Euratom Directive 2003/122 on the control of the high-activity sealed radioactive sources and orphan sources (HASS). In case the source user or the supplier bankrupts, the government will cover the additional funds needed for disposing of the source.

In Greece there are no manufacturers of sealed sources; all sealed sources are imported.

A programme exists for collecting all spent and disused sources, imported into the country before 1990. Up to now, the old “legacy” sources have been collected and exported to a foreign country with the appropriate infrastructure for recycling according to a programme started by the GAEC in 2003 and financed by the government. Mainly industrial and medical sources of different types and activities were exported.

This action will be repeated when a significant number of non-used sources is collected again. In the mean time, the collected sources (bankrupt source user, scrap yards, foundries, etc) are waiting for exportation in the interim storage facility located in the campus of NCSR “Demokritos”.

GAEC maintains the National Data Base, including information about installations, laboratories, equipment, sources, occupationally exposed workers, etc.

In addition to the provisions taken to prevent the smuggling of radioactive sources or nuclear material into the country (section J, art. 27), radioactivity detectors (portals) have been installed in the scrap yards and foundries to monitor the scrap entering these facilities and detect any hidden sealed sources. In case of a finding, the persons in charge communicate immediately with GAEC, so as to perform a secondary control and collect the object, if needed.

SECTION K.
PLANNED ACTIVITIES TO IMPROVE SAFETY

Greece plans to take steps towards the strengthening of the safety of radioactive waste management. In this context, the following steps have been already initiated:

1. Greece has asked for an IRRS mission. The mission is in progress, the self assessment part is planned to be competed at the end of the year, the preparatory meeting has been held and the final review mission has been planned for May 2012. Radioactive waste management was decided as the first policy issue to be developed. The research reactor will be included at the follow up mission. Greece considers this mission as a unique opportunity to improve its regulatory framework, in terms of both effectiveness and compliance with IAEA standards.

2. A Presidential Decree for the transposition of the EC Directive 2009/71/Euratom, establishing a Community framework for the nuclear safety of nuclear installations has been drafted and it is at the relevant Ministries for signature.

3. A Ministerial Decree under the above Presidential Decree is under preparation.

4. The update of the licensing process of the GRR-1, according to which decommissioning plan and waste management will be submitted as part of the safety analysis report.

SECTION L.
TABLES

(a) Inventory of irradiated fuel assemblies in interim storage at the reactor building.

Assembly no.	U-235 (gr)	Burn-up (%)
601	200,67	9,50
602	188,62	14,92
603	218,81	1,37
604	187,63	15,45
605	192,69	13,14
606	188,36	15,02
607	195,29	11,96
608	193,74	12,68
609	197,39	11,04
610	197,95	10,73
611	194,33	12,40
612	199,52	10,03
613	198,58	10,41
614	206,23	6,98
615	208,14	6,09
616	209,82	5,34
617	218,51	1,41
618	219,04	1,22
6C01	89,23	34,02
6C02	105,14	18,03
6C03	108,33	14,86
6C04	113,10	10,09

(b) Radioactive waste produced from GRR-1 refurbishment works from 2008 to 2010.

Task	Waste type	Date	Volume (L)	Nuclides	Activity (kBq)	Route
Pool Decontamination	Sediment	4/2010	2	Eu-152	30	Storage, NCSRD Waste Management
				Ag-108m	50	
				Co-60	220	
Pool Drainage	Water	3/2010	30000	Ag-108m	55	Released to sewage through NCSRD liquid waste management facility
				Cs-137	67	
				Co-60	210	
Old delay tank decontamination	Water	7/2008	36000	Co-60, Cs-137, Ag-108m, Eu-152	<500	Released to sewage through NCSRD liquid waste management facility
Spent fuel pool	Water	5/2011	8944	H-3	569×10^{3}	Storage, NCSRD Liquid waste storage tanks
				Cs-137	47	
				Co-60	51	

(c) Radionuclides supplied to the NCSR "Demokritos" in 2010 that eventually becomes waste.

Radionuclides used	Radioactivity (MBq)	Practice
H-3	18.5	Biology and Radio-pharmacy and in vitro radio-diagnostic
Re-188	7400	Biology Radio-pharmacy and in vitro radio-diagnostic
Lu-177	5550	Biology and Radio-pharmacy and in vitro radio-diagnostic
I-125	1177	Radio-pharmacy and in vitro radio-diagnostic
Fe-59	185	Radio-pharmacy and in vitro radio-diagnostic
In-111	3515	Biology and Radio-pharmacy and in vitro radio-diagnostic

(d) Radionuclides used in nuclear medicine that result in wastes for the year 2010.

Radionuclide	Radioactivity (GBq)	Use
Mo/Tc-99m	50450	Diagnosis (in vivo)
Tl-201	2895	Diagnosis (in vivo)
In-111	313	Diagnosis (in vivo) & Therapy
I-123	185	Diagnosis (in vivo)
I-131	8684	Diagnosis (in vivo) & Therapy
I-125	10.3	Diagnosis (in vitro)
Y-90	88	Therapy
Ga-67	121	Diagnosis (in vivo)
Re-186	70	Therapy
Sm-153	721	Therapy
Sr-89	4.7	Therapy
H-3	3.6	In vitro
C-14	0.006	In vitro
P-32	3.6	In vitro
P-33	0.037	In vitro
S-35	3.03	In vitro
Cr-51	6.4	In vitro
Co-57	0.006	Diagnosis (in vitro)
Lu-177	6.1	Therapy
F-18	16000*	Diagnosis (in vivo)

* Calibration radioactivity at the packaging time (i.e. before transported to end-user)

(e) Radionuclide activity in the primary resin waste. The waste is separated into 158* drums of 100 Kg.

Radionuclide	Radioactivity (MBq)
Ag-108m	15
Cs-137	213
Eu-152	4
Co-60	13

*10 drums of primary resin satisfy the general clearance criterion, 115 drums of primary resin satisfy the clearance criterion for disposal at a landfill and 33 drums of solidified in cement resin will have been disposed gradually at a landfill until 2031.

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