OSPAR COMMISSION

Protecting and conserving the North-East Atlantic and its resources

Portuguese Seventh Round Implementation Report of PARCOM Recommendation 91/4 on Radioactive Discharges

Radioactive Substances Series

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PORTUGUESE IMPLEMENTATION

PORTUGUESE ENVIRONMENT AGENCY (APA)

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INTRODUCTION

PARCOM Recommendation 91/4 states that contracting parties agree “to respect the relevant Recommendations of the competent international organisations and to apply the Best Available Technology to minimise and, as appropriate, eliminate any pollution caused by radioactive discharges from all nuclear industries, including research reactors and reprocessing plants, into the marine environment. Contracting Parties shall present a statement on progress made in applying such technology every four years in accordance with the guidelines annexed to this recommendation”.

This document, which is the second submitted by Portugal, has been elaborated according to the new guidelines and contains information, over the period 1986-2018 inclusive, on the Portuguese nuclear facility located in the OSPAR Convention Area.

PART I – GENERAL INFORMATION

1. Radiation protection and nuclear safety authorities in Portugal

Portuguese Environment Agency (APA) is a Public Institute under the responsibility of the Portuguese Ministry of the Environment and Climate Action. APA´s mission is to propose, develop and monitor, on an integrated and participated manner, the public policies for the environment and sustainable development, in close cooperation with other sectorial policies and public and private entities.

The Decree-Law 108/2018 of 3 December 2018 establishes the legal regime for radiation protection and assigns the Portuguese Environment Agency (APA) as the competent authority and the Inspectorate-General for Agriculture, Sea, Environment and Spatial Planning (IGAMAOT) as the inspectorate authority for Radiological Protection and Nuclear Safety.

To this effect, APA’s internal structure was reformulated and a new department was created. , Department for Emergencies and Radiation Protection (DEPR) that is divided in 3 areas, Authorization and Nuclear Safety Division (DAN), Environmental Planning and Protection Division (DPA) and t Planning and Response to Emergencies Unit (EPRE). This new Department foresees a total of 19 people, with 1 Director and 3 Division Heads. Also the internal structure of IGAMAOT was reformulated by the creation of an inspection department for Ionizing radiations inspections.

The current resources are allocated based on the premise that the regulatory body would have to grow and gain further experience and human resources, in a manner that is appropriate for the radiation risks associated with the existing facilities and activities, taking into account a graded approach.

2. National legislation and basis for regulation

The Portuguese radiation protection policy is based on UE Directives, on international conventions and on recommendations of appropriate international bodies like the International Commission on Radiological Protection (ICRP) and the International Atomic Energy Agency (IAEA).

The Portuguese legal framework for protection against the dangers arising from exposure to ionising radiation is established by Decree-Law 108/2018 of 3 December 2018, published in the Portuguese Official Journal (DR – Diário da República) No. 232, 1st Series, of December 3, 2018. This regulation was supplemented with Ministerial Orders no. 136/2019, no. 137/2019, no. 138/2019 and no. 293/2019, the first three published in DR No. 90, Series I, of May 10, and the last in DR No. 171/2019, Series I, of September 6. These regulations transpose Directive 2013/59/EURATOM of the Council of the European Union into the Portuguese law.

In the previous legislation the competencies of regulatory authority were distributed by several institutions, some institutions accumulated both regulatory and operator roles and the resources were shared with other tasks.

The new legal framework (Decree-Law No.108/2018 of 3 December 2018) that entered into force at 2nd of April 2019, consolidates the Regulatory and Inspection competencies in APA and IGAMAOT respectively, allowing these institutions to carry out their competencies independently and functionally separated from any other organization related to the promotion or use of practices, with human, technical and financial resources needed for functioning. In this framework APA and IGAMAOT also succeed the previous competent authorities for nuclear safety and radioactive waste management.

In addition, the following Portuguese regulations provide specific regulation on different fields of radiation protection:

- Decree Law No. 156/2013 of November 5 (DR No. 214/2013, 1st Series) establishes the legal and regulatory framework for the responsible and safe management of spent fuel and radioactive waste. This Decree Law is the transposition of Council Directive 2011/70/Euratom into the Portuguese law. The exemption and clearance levels, as required by Decree-Law 156/2013, have been established initially in the Ministerial Order 44/2015, of February 20, which was replaced in 2019 by the Ministerial Order no. 138/2019, of May 10. Furthermore, the Council of Ministers Resolution no. 122/2017 approves the Portuguese programme concerning the safety of spent fuel and radioactive waste management for 2015 2019. The regulatory body, APA, is preparing the programme for the next 5 years.
- Decree Law No. 30/2012 of February 9 (DR No. 29/2012, 1st Series) transposes the Council Directive 2009/71/Euratom, which establishes a Community framework for the nuclear safety of nuclear installations. In addition, Decree Law No. 262/2012 of December 17 (DR No. 243/2012, 1st Series) establishes the obligations of license holders of nuclear installations. These Decree Laws were modified by Decree Law No. 135/2017 of October 20 (DR No. 203/2017, 1st Series) in accordance with the Council Directive 2014/87/Euratom amending Directive 2009/71/Euratom.

3. Implementation of BAT/BEP in Portugal

The Best Available Techniques (BAT), are defined as ‘’the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for release limitations designed to prevent and, where that is not practicable, generally to reduce releases of radioactive elements and their impact on the environment as a whole’’.

The Best Environmental Practices (BEP) are defined as ‘’the application of the most appropriate combination of environmental control measures and strategies.’’

In the country´s context, BAT and BEP were introduced at different levels of the Portuguese legislation and regulation in order to reduce the levels of the radiological impact on people and the environment.

Under the article 13 of the Decree-Law 108/2018, the obligations of the competent authority are:

b) Propose the adoption of laws and regulations in the field of radiological protection and safety, aiming a continuous improvement of the activity regulation instruments and the monitoring of technical development;

c) Issue the necessary guidelines for the implementation of the provisions of this decree-law, within the scope of its competence;

i) Determine that the holder takes corrective actions, if unsafe or potentially unsafe conditions are detected in facilities where authorized practices are carried out;

j) Establish, whenever necessary, the maximum dose restriction value;

k) Establish reference levels in accordance with the provisions of articles 90, 95, 123, 131, 142 and 148, as well as others defined in a specific diploma;

w) Maintain operational a continuous measurement network so that situations of abnormal increase in radioactivity in the environment can be detected and update the record of measurements made by this network;

x) Propose corrective measures to guarantee the protection of the environment and populations in situations of emergency exposure or situations of existing exposure and ensure coordination of the radiological aspects of environmental remediation;

ai) Ensure the correct monitoring of radioactive discharges;

al) To ensure the monitoring of radioactivity in the environment and the management of the radioactivity monitoring program in the environment;

The Article 6 of this decree-law, establishes that "the radiation protection of persons subject to occupational exposure or public exposure should be optimized in order to maintain the value of individual doses, the probability of occurrence of exposures and the number of people exposed, as low as reasonably possible, taking into account the current state of technical knowledge and economic and social factors". So, to establish the Best Available Techniques (BAT) all practices must be analysed, in accordance with the requirements that the regulator establishes.

The licensing procedure of a radiological practice carried out by the competent authority, APA, establish authorised limits and conditions for discharging radioactive effluents taking into account the results of the optimisation of radiation protection and the operation of the facility should reflect a good practice.

4. Regulation on Nuclear and Radioactive Facilities

The Decree-Law Nº 30/2012, of February 9 (amended by Decree-Law 135/2017, 20 October), transposes the provisions of Directive No. 2009/71/Euratom, of the Council, as amended by Directive No. 2014/87/Euratom, which establishes a Community framework for the nuclear safety of nuclear installations, and creates the respective authority into the internal legal order the competent regulator, establishing its scope and powers. In article 2 is stated that "the present diploma applies to any civil nuclear installation in national territory subject to a license, as well as to the regulation of the activities of these installations".

Its objectives are:

a) The preservation and promotion of the continuous improvement of nuclear safety and its regulation;

b) The adoption of provisions leading to a high level of nuclear safety, which protects workers and the general population from the risks of nuclear contamination.

In the Decree-Law Nº 262/2012, of December 17, is created the regime that establishes the obligations for the holders of licenses for nuclear installations, so that they verify and continuously improve their safety, under the supervision of the regulatory authority created by Decree-Law No. 30/2012, of 9 February.

In terms of nuclear installation safety, article 4 (amended by Decree-Law 135/2017, 20 October), states that:

"The operator is responsible for the nuclear installation, from the choice of the site to its dismantling.

The nuclear installations must be located, designed, built, put into service, operated and dismantled in order to prevent accidents and, in the event of an accident, to minimize the respective consequences and avoid:

a) Early radioactive releases, which would require emergency measures outside the premises, without however enough time to put them into practice;

b) Substantial radioactive releases, which would require protective measures that would not be possible to limit in time or space.

The operator bears the primary responsibility for the safety of the installation, including the promotion and continuous reinforcement of a true nuclear safety culture, under the control of the regulatory authority, which cannot be delegated or transferred and includes responsibility for the activities of contractors and subcontractors whose activities may affect the nuclear safety of a nuclear installation.

The granting of a license for the construction or operation of a nuclear installation is based on an appropriate specific assessment of the site and the installations that includes the demonstration of nuclear safety with respect to national nuclear safety requirements based on the objective defined in the paragraph 2".

The Decree-Law Nº 108/2018, of December 3, establishes the new legal regime for radiation protection, as well as the powers of the competent authority and the inspection authority for radiation protection, transposing the Council Directive 2013/59/Euratom, of 5 December, into the internal legal order, which sets the basic safety standards for protection against hazards resulting from exposure to ionizing radiation.

5. Regulation on radioactive discharges on the Environment

The article 95, of the Decree-Law N.º 108/2018, regulates the monitoring of radioactive discharges, which indicates, in point 1, "the holder whose license includes, during normal operation, the discharge of gaseous effluents or radioactive liquids into the environment must monitor or evaluate the mentioned discharges and communicate the results to the competent authority". In point 2, "the holder responsible for a nuclear reactor or for reprocessing installations must monitor the radioactive discharges and report them in a standardized and periodic manner, in terms to be defined by the competent authority".

APA, as the competent authority, is responsible for ensuring the existence of a high level of radiological protection and nuclear safety, safe management of spent fuel and radioactive waste (article 12 of DL 108/2018), and ensure the correct monitoring of radioactive discharges (article 13 of DL 108/2018).

6. Evaluation of the Environmental Impact

Decree-Law 138/2005 of August 17th establishes a national environmental monitoring system to measure the level of radioactivity in air, water and soil, in compliance with the monitoring and reporting requirements (under Articles 35 and 36 of the Euratom Treaty, and in accordance with the Recommendation of the European Commission, of 8 June 2000 (COM/473/EURATOM)). This Decree-Law has been repealed by the Decree-Law 108/2018 of December 3rd. These regulations transpose into the Portuguese law, the Directive 2013/59/EURATOM (European Atomic Energy Community) of the Council of the European Union. A Ministerial Order defining the new national environmental monitoring system will be published soon, establishing the means of sampling, the types of measurements, their periodicity and the minimum requirements for each record, in order to control the degree of radioactivity in the atmosphere, water and soil. Until that, the DL 138/2005 is still in place.

As a competent authority, APA is in charge of the following tasks: develop and update the environmental radiological surveillance plan; communicate, under Article 35 and 36 of the Euratom Treaty, the results of the level of radioactivity to which the public is exposed to the European Commission; radiological monitoring around the old uranium mines; evaluate the radiological safety of industries processing materials containing naturally-occurring radionuclides (NORM); operation of an online, real-time, alert radiological monitoring network (RADNET).

APA delegated in the Instituto Superior Técnico – IST, the responsibility for environmental sampling and analytical measurements.

7. Dose Limits for the Portuguese Research Reactor

In Portugal, dose limits for the Portuguese Research Reactor (RPI) are established by Decree-Law No. 262/2012 of 17 December, as amended by Decree-Law 135/2017, meeting the requirements of Council Directive 2009/71/EURATOM, as amended by Directive No. 2014/87/Euratom, of which stand out:

The limits for the release of radioactive effluents from a nuclear installation are established on a case-by-case basis based on a safety analysis, and are included in the safety analysis report of the installation.

8. Discharges Limits

Regarding the discharge limits, applicable to liquid and gaseous effluents considered as a whole, were established in 2007 by the Competent Authority, having as a base the safety analysis report.

<u>Annual Limits for Gaseous effluents</u>

Noble Gases	20TBq
Particles	200MBq
Iodine 131	100MBq
H-3	5GBq
C-14	5GBq

<u>Annual Limits for Liquid effluents</u>

H-3	500MBq
C-14	500MBq
β Emissions (other than H-3 and C-14)	500MBq

These values, applicable to liquid and gaseous effluents considered as a whole, were established as a proper Dose Constraint for the Portuguese Research Reactor.

9. Environmental Monitoring Programmes

The monitoring of radioactivity in the environment is a national concern, operating within three agreements:

- ✓ The Euratom Treaty which, in its Article 35, requires Member States to establish permanent control structures for radioactivity in the atmosphere, waters, and the soil, in order to ensure checks on compliance with basic standards for the protection of the health of populations and workers against the dangers resulting from ionizing radiation.

- ✓ From the appropriate authorities, is required to periodically communicate information on the checks referred to in Article 35 to the Commission so that it is kept informed of the level of radioactivity to which the public is exposed (article 36).
- ✓ The OSPAR Convention, whose strategy for a Joint Assessment and Monitoring Programme (JAMP) provides for the establishment of a program of monitoring for radioactive substances in the marine environment.

The Environmental Radiological Monitoring Programme was defined according to the specificities of the country. This programme was carried out through three specific monitoring programs:

- a national level program
- a program dedicated to the IST Campus Tecnológico e Nuclear (CTN) were the Portuguese Research Reactor is located
- a program dedicated to the regions surrounding the former Uranium mines.

These programmes consist of measuring artificial and natural radionuclides in environmental compartments (atmospheric, aquatic and terrestrial environments) considered as direct pathways of contamination to humans. Samples of aerosols, rainwater, surface water, sediments and aquatic plants, drinking water, mixed diet, complete meals, milk and soils samples are analysed. Automatic ambient dose rate monitoring (active detectors) and integrated measurements of the ambient dose with thermoluminescent dosimeters (passive dosimeters) are also performed.

Portugal installed, in 1989, a Continuous Surveillance Network for Radioactivity of Ambient Air (RADNET), in application of the International Convention on Rapid Notification in the event of a Nuclear Accident or Radiological Emergency (approved and ratified by decree of the President of the Republic no. 15/92 of 3 July on Resolution of the Assembly of the Republic no. 22/92, of 2 April) and the decision of the Council of the European Communities no. 87/600 / EURATOM, under the responsibility of the Emergency and Environmental Risks Office. RADNET includes 7 Envinet DLM1450 stations, which measure gamma dose rates (H*(10)) only, and 10 Envinet Sara Stations, which measure gamma dose rates (H*(10)) and have spectrometric capabilities and increased sensitivity. This stations are installed across mainland and the Madeira and Azores Archipelagos. RADNET also includes two continuous water monitoring stations deployed in the Tagus and Douro international rivers. These stations are also from the manufacturer Envinet, model Sara Water, measuring the gamma dose rate (H*(10)) and having also spectrometric capabilities. At the Talavera La Real airbase, Badajoz (Spain), a Portuguese fixed station is installed and a Spanish fixed station belonging to REVIRA (Spanish Network) is installed in Penhas Douradas. These stations are used for data intercomparison and have been operational since July 1996.

PART II - SITE SPECIFIC INFORMATION

1. The Portuguese Research Reactor

The Instituto Superior Técnico mission is to contribute to the development of society, promoting quality Higher Education in the areas of Architecture, Engineering, Science and Technology, in the areas of undergraduate, graduate and lifelong training, and developing activities of Research, Development and Innovation (ID&I), essential for the progress of knowledge, and for teaching at the level of the highest international standards.

The Technological and Nuclear Campus (CTN) is one of the three campuses of the Instituto Superior Técnico and where the Portuguese Research Reactor (RPI) is located. This campus resulted from the integration in March 2012 of the former Technological and Nuclear Institute (ITN).

The Portuguese Research Reactor (RPI), with a 1MW thermal power, is a light-water moderated, heterogeneous, solid fuel reactor in which water is used both as shielding and cooling. The reactor core is immersed in a two section concrete pool. One of these sections contains an experimental stall into which beam tubes and thermal column converge. The other section is an open area in front of a dry irradiation window and a gamma room. The reactor can be operated in both sections.

The reactor core is supported by an aluminium structure suspended from a mobile bridge. Control of the reactor is accomplished by the insertion or removal of neutron control rods which are suspended from control drives mounted on the reactor bridge. Heat created in the core is removed by a forced circulation cooling system and dissipated to atmosphere from the heat exchanger by a secondary cooling system.

In operation since 1961, with an interruption of 3 years in the late eighties, for refurbishment, this included changes in the fuel enrichment from low enriched uranium (LEU) to highly enriched uranium (HEU). During 1999 all the LEU spent fuel was returned to the USA under an agreement which covers the return of the present fuel until 2009. In 2007, the HEU was replaced by LEU fuel.

The RPI was shutdown on 11 May 2016, for annual maintenance followed by preparation for structural inspections recommended by the integrated Safety Assessment of Research Reactors (INSARR) mission made in February of that year. It was decided in September 2017 to make the permanent shutdown and start preparations to send the LEU fuel to the USA, where the uranium had been enriched, before May 2019, deadline of the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program. The LEU fuel Shipment was completed in March 2019.

2. Location of the Portuguese Research Reactor

The Portuguese Research Reactor (RPI) is the only civil nuclear installation in the country and the only research reactor in the Iberian Peninsula. The RPI is operated by the IST and is located at the Technological and Nuclear Campus in Loures, 12 km from the centre of Lisbon and 30 m above the average sea level.

Figure 1 - Localization of the Portuguese Research Reactor (RPI).

3. Year for licensing/decommissioning

The RPI was permanent shutdown in 2017 and the transfer of the fuel was done in 2019. It is currently inactive and waiting for the decommissioning process to start.

4. Radioactive Liquids Effluents Discharge Control Facility

CTN is structured in three research units, the Nuclear Engineering Laboratory (LEN), integrating the Portuguese Research Reactor (RPI), the Laboratory of Radiological Protection and Safety (LPSR) and the Laboratory of Accelerators and Radiation Technologies (LATR).

Figure 2 – Localization of Units inside CTN.

All these facilities are connected to the Radioactive Liquids Effluents Discharge Control Facility (ECoDELiR) where the radioactive liquids effluents are discharged. Figure 3 shows the sewage system of CTN.

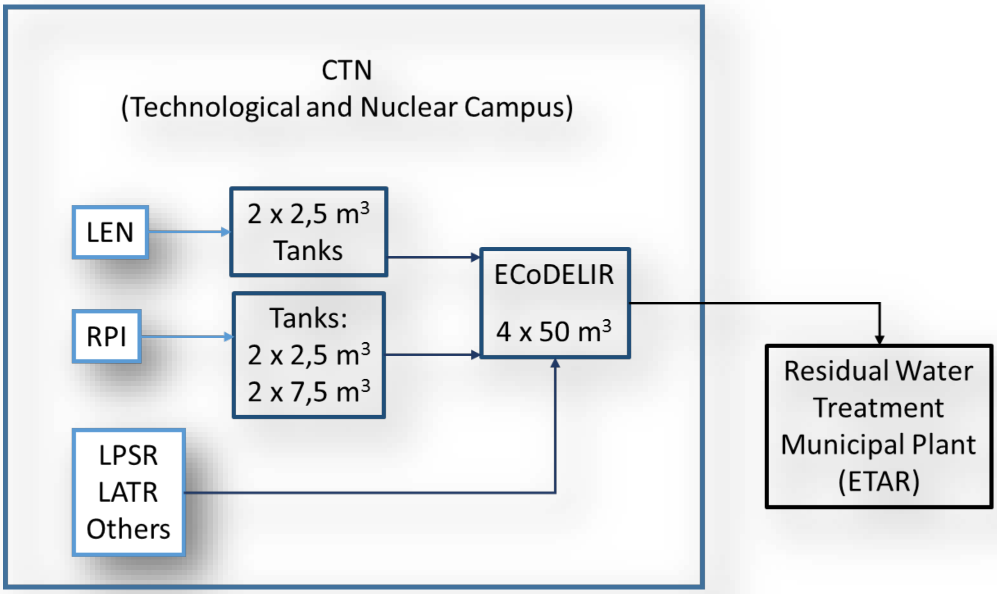

Figure 3 - ECoDELiR – sewage system of CTN.

The effluents from the Portuguese Research Reactor (RPI) are mainly from the washing waters, treatment waters of the ion-exchange resins used to treat the swimming pool and leakage waters. The RPI discharge pipe system ends up in four metallic retention tanks located outside the building and below ground level (9 m), two of them with 2.5 m^3 of capacity each and the other two with 7.5 m^3 of individual volume each. Radiochemical, radiopharmaceutical and radioisotopes laboratories are operated by LEN and the effluents are discharged into two metallic tanks with 2.5 m^3 capacity each. The others units discharge their effluents directly into ECoDELiR.

5. Improvements at ECoDELiR

The Instituto Superior Técnico (IST) complies with the operational licence and minimize the releases of radioactive substances to the environment through the application of appropriate technologies. The ECoDELiR was object of improvements in order to comply with PARCOM Recommendation 91/4 of OSPAR Convention and Article 35 of the Euratom Treaty.

In the last years the equipment (engines, pipes, valves, etc.) was completely revised, and the four tanks were improved (Figure 4).

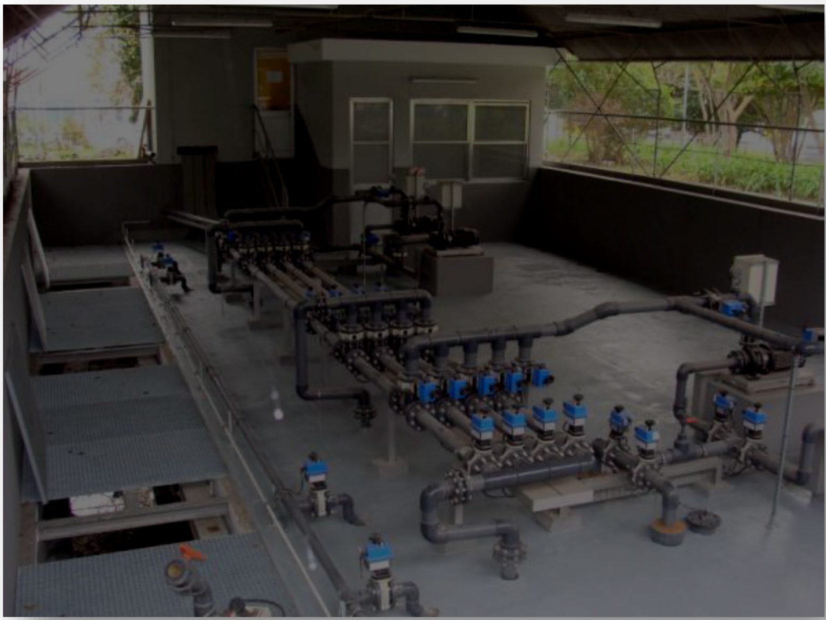

Figure 4 – Picture of the sewage system.

ECoDELiR is divided in two groups that can operate independently, in order to collect and store liquid effluents in case of an eventual accident occurs in one of the facilities.

6. Control of radioactive liquid discharges

Before discharge the effluents to the Municipal Residual Water Treatment Plant (ETAR), the effluents are collected in the tanks of the Radioactive Liquids Effluents Discharge Control Facility (ECoDELiR). This system (ECoDELiR) is divided in two groups that can operate independently, in order to collect and store liquids effluents if an eventual accident occurs. Samples are taken and analysed in laboratory, by gamma spectrometry with NaI (Tl) detectors, in order to quantify the artificial radionuclides present before discharge to the ETAR.

7. Specific Monitoring Program for Technological and Nuclear Campus (CTN)

IST has a specific Environmental Radiological Monitoring Program for the CTN, with the main objectives:

- Evaluate the levels of radioactivity in the external environment of the RPI in CTN, as well as its tendency to vary and detect any changes;
- Verify that the discharge limits established by the RPI are respected and allow timely intervention in case of unplanned conditions;
- Contribute to obtain data that allows assessing the exposure of members of the public and workers;
- Establish a data support and organization that facilitates the information to the public and competent entities.

The program is based on the environmental monitoring of external radiation, through the assessment of the environmental gamma dose using continuous measurements and integrated measurements, on the monitoring of atmospheric radioactivity, through the sampling and analysis of aerosols and on the monitoring of the transfer of radionuclides by deposition, through the analysis of rainwater samples and the analysis of samples of the topsoil. It also assess the discharges (liquid and gaseous) to the environment. Sampling locations and type are shown in Figure 2 and Figure 5.

Figure 5 - View of the area surrounding the CTN, including the location of soil sampling points (outside and inside the campus).

8. Atmosphere Radioactivity

8.1. Aerosols

Concerning to air emissions, an off-line aerosol sampling station was installed at CTN for further measurement of gamma emitters in aerosol filters by high-resolution gamma spectrometry.

Figure 6 shows the results obtained for the radionuclides Be-7, Pb-210, Cs-137 and PTS (represents the average year concentration of total suspended particles) for the years between 2007 and 2018. The total annual activity observed didn't show any values above the Emission Limits for the Licensee of the RPI.

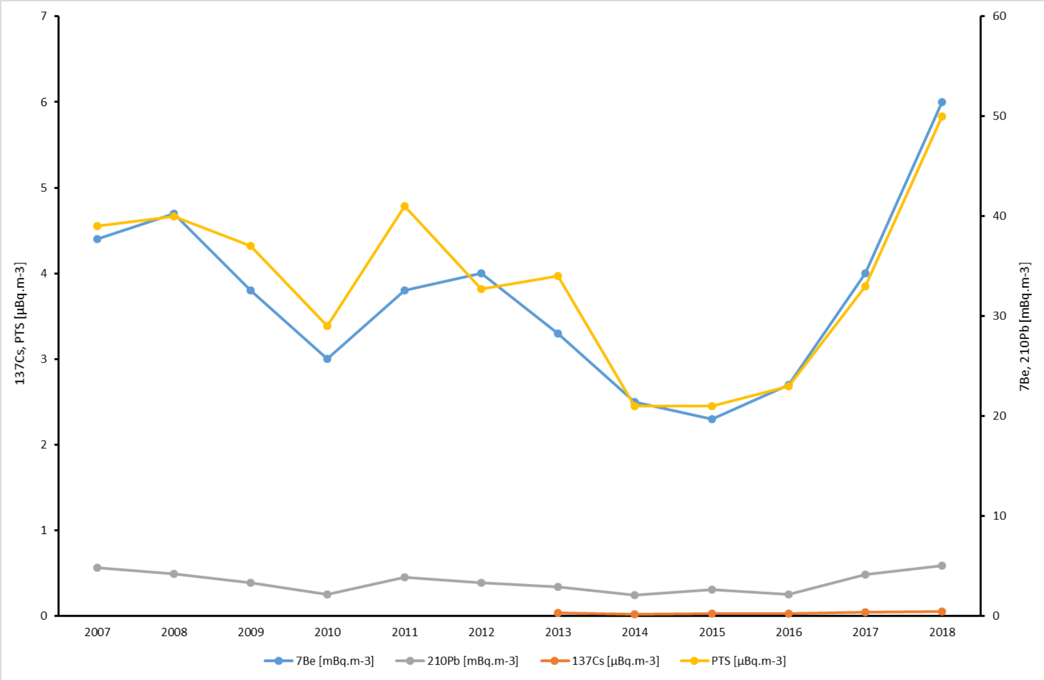

Figure 6 - Temporal variation of the activity concentration of ^{7}Be ^{210}Pb and Cs$^{137+´«’ς-ς-}$and concentration of suspended particles (µg.m^{-3}) in aerosols collected at CTN.

8.2. Atmospheric Total Deposition (wet and dry)

The values for total alpha and beta activity concentration resulting from atmospheric deposition, where obtained by analysing monthly rainwater samples collected at CTN. The annual accumulated precipitation between 2007 and 2018 and the annual average values total alpha and beta activity in the atmospheric deposition are represented in Figure 7.

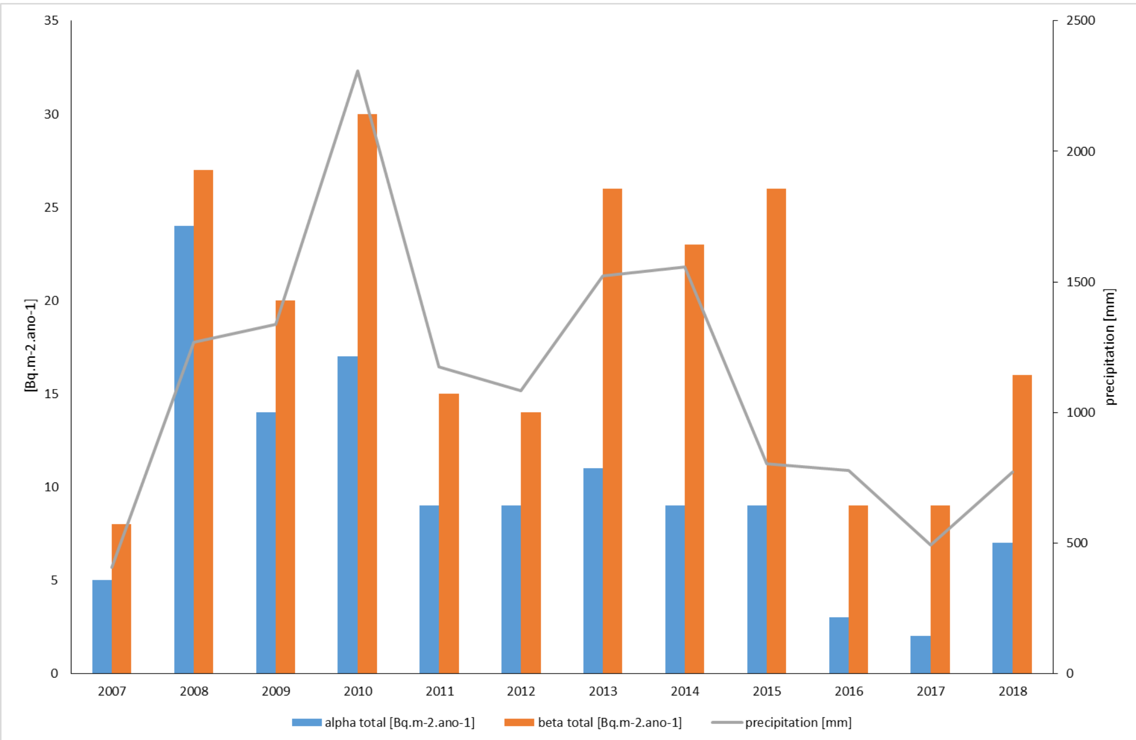

Figure 7 - Temporal variation of total alpha and beta activity resulting from atmospheric deposition and precipitation values at CTN.

The average activity concentration values in natural and artificial radionuclides measured in rainwater samples collected on the CTN campus were low throughout the years and in the same order of magnitude observed between 2007 and 2018. The accumulated rainfall over 2018 (773 mm) was higher than the accumulated rainfall in the previous years of 2015, 2016 and 2017 (491 mm).

The annual deposition rate obtained for total alpha activity and total beta activity are in the same order of magnitude between the years presented here.

9. Soil Radioactivity

Figure 8 shows the activity concentration variation through the years (in Bq.kg^{-1}) of natural and artificial gamma emitters detected in soil samples collected on CTN.

The activity concentration values in ^{137}Cs varied between 2.2 Bq.kg^{-1} and 6.6 Bq.kg^{-1}, corresponding to trace values, in the same order of magnitude of those obtained in soil samples from different regions of the country and showing no significant changes in relation to the range of values reported CTN.

Between 2007 and 2018, the ^{131}I specific activity values were below the minimum detectable activity. These results do not show any evidence of contamination from existing facilities on the CTN.

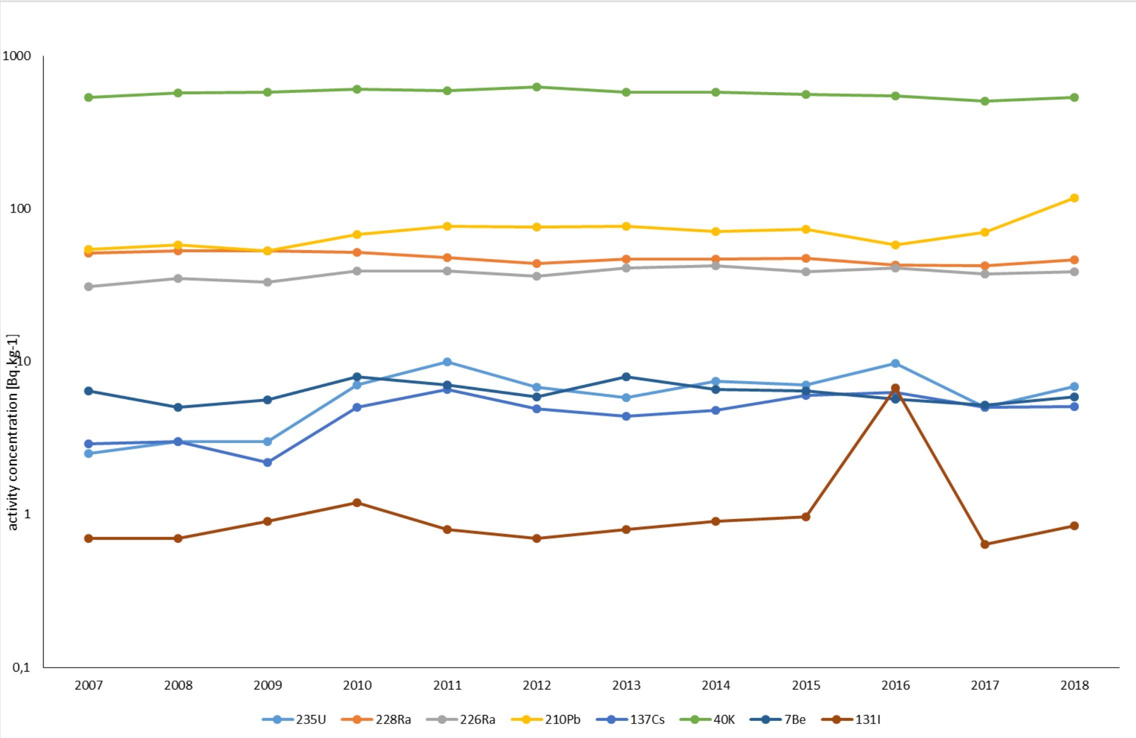

Figure 8 – Temporal variation of activity concentration of natural and artificial gamma emitters in soil of the CTN campus.

10. Environmental Radiation Dose

10.1. Active Detectors

Between 2007 and 2018, the ambient dose equivalent rate varied between 92 and 118 nSv.h^{-1} on the detector located on the roof of the Library building, between 96 and 130 nSv.h^{-1} at the detector located next to the Maintenance Facility and between 153 and 206 nSv.h^{-1} at the detector located next to the LPSR (referred to as PPR1 in relation to passive detectors). Figure 9 shows the evolution of average monthly values in the period between 2007 and 2018.

It can be seen through the graph on figure 9 that the average values of the ambient dose equivalent rate recorded by the probes located in the Library and next to the Maintenance Facility are similar. On the other hand, the ambient dose equivalent rate at the point located next to the LPSR are significantly higher than those recorded in other locations. The persistence in the occurrence of higher values at this measurement point is due to the fact that the probe is located in the vicinity of the radioactive waste storage facility for medium and low activity in the CTN. This fact is also observed in the results of the passive detectors, specifically those located in the surroundings of the radioactive waste storage facility (PRR1, PRR2, PRR3 and PRR4), whose average value of the ambient dose equivalent rate varied between 149 nSv.h^{-1} and 182 nSv.h^{-1}.

In other terms, the results presented are consistent with those obtained through passive detectors (Figure 10), which does not indicate the occurrence of any accidental emission.

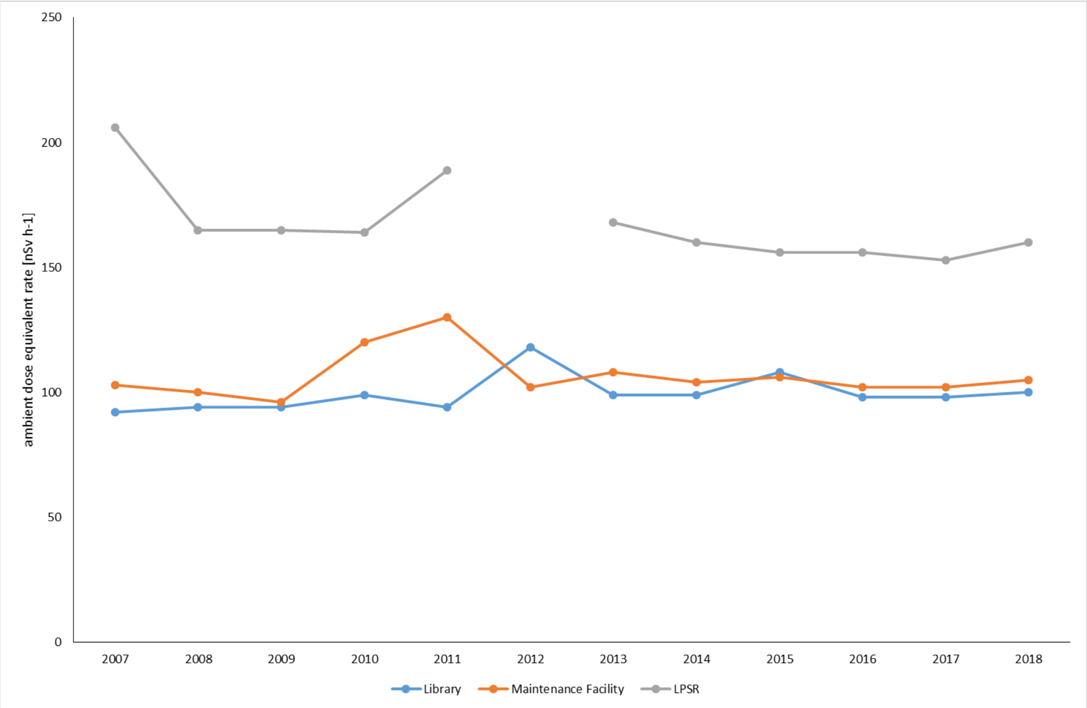

Figure 9 – Temporal variations of the ambient dose equivalent rate at the CTN measurement sites (values expressed in nSv h^{-1})

10.2. Passive Detectors

Figure 10 shows the average values of the ambient dose equivalent rate measured at the seven points located in the CTN, calculated from the readings made between the years 2007 and 2018.

It is observed that the average values of the ambient dose equivalent rate measured at the points Maintenance Facility, Administration and LMRI are similar, and that the values measured at the measurement points PRR1, PRR2, PRR3 and PRR4 are systematically higher. These last measurement points are located close to the radioactive waste storage facility, and probably for this reason the measured values are systematically higher than those recorded in the other three measurement points.

In general, it is observed that the average annual values, recorded in each measurement year are similar to those recorded in previous years. The measured values presented in Figure 10 are values considered normal, compatible with previously published values.

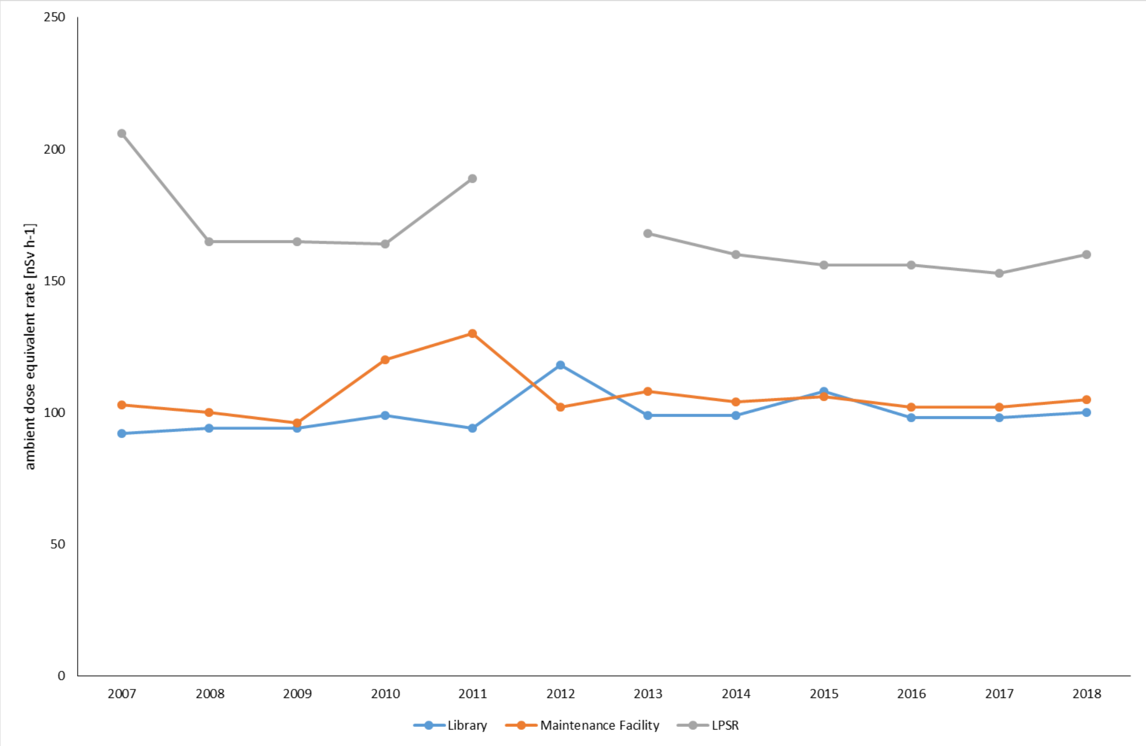

Figure 10 - Average values of the flow rate equivalent of the ambient dose measured at each measurement point in the CTN in each quarter and the respective annual average value (values expressed in nSv.h-1).

11. SOURCE MONITORING – Net Discharges

During 2018, the control of the levels of radioactivity in the liquid effluents received at the Radioactive Liquid Effluent Discharge Control Station (ECoDELiR) and discharged to the Waste Water Treatment Plant (WWTP) was carried out through discrete sampling. The analyses of the effluent samples were carried out in the measurement laboratory of the Operational Nucleus of Radiological Protection (NOPR).

The total activity discharged during 2018 was 0.62 MBq, significantly lower than the total activity discharged in previous years (2 MBq in 2017, 49 MBq in 2016 and 89 MBq in 2015).

In Figure 11 and in Figure 12, it is possible to see the discharged activity (in MBq) and volume (in m^3) since 2007. The activity limit for liquid discharges was 500 MBq (or 740 Bq/L).

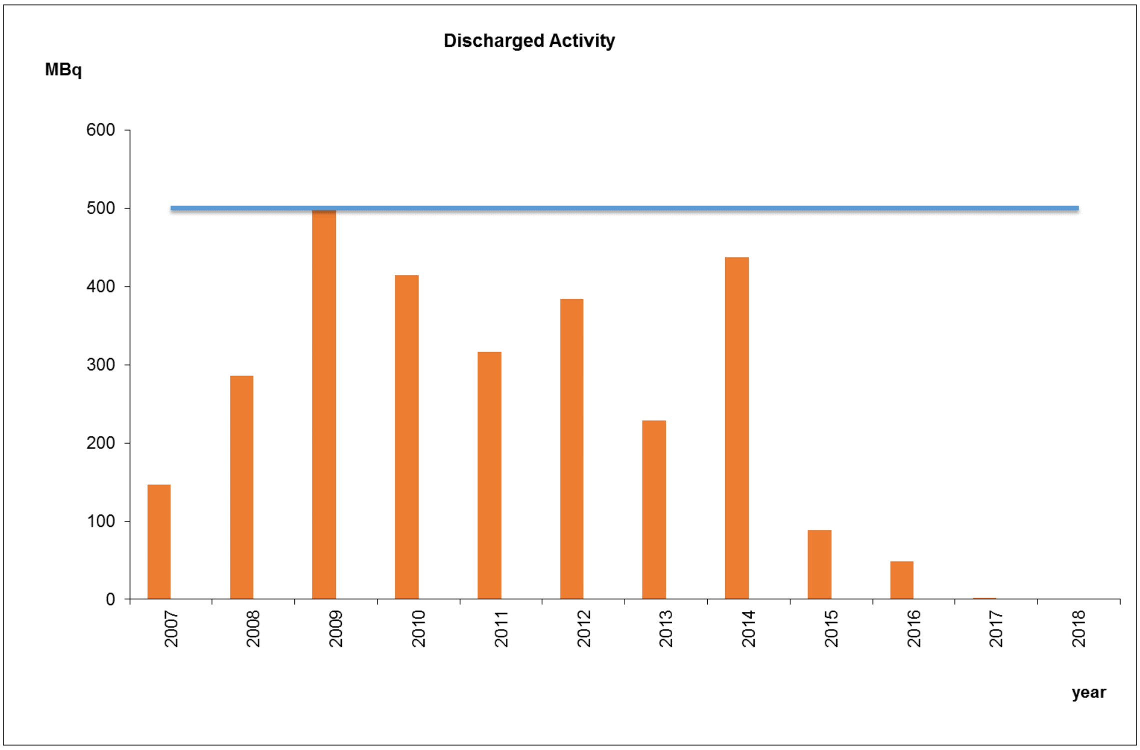

Figure 11 - Discharges activity from the RPI since 2007 until 2018.

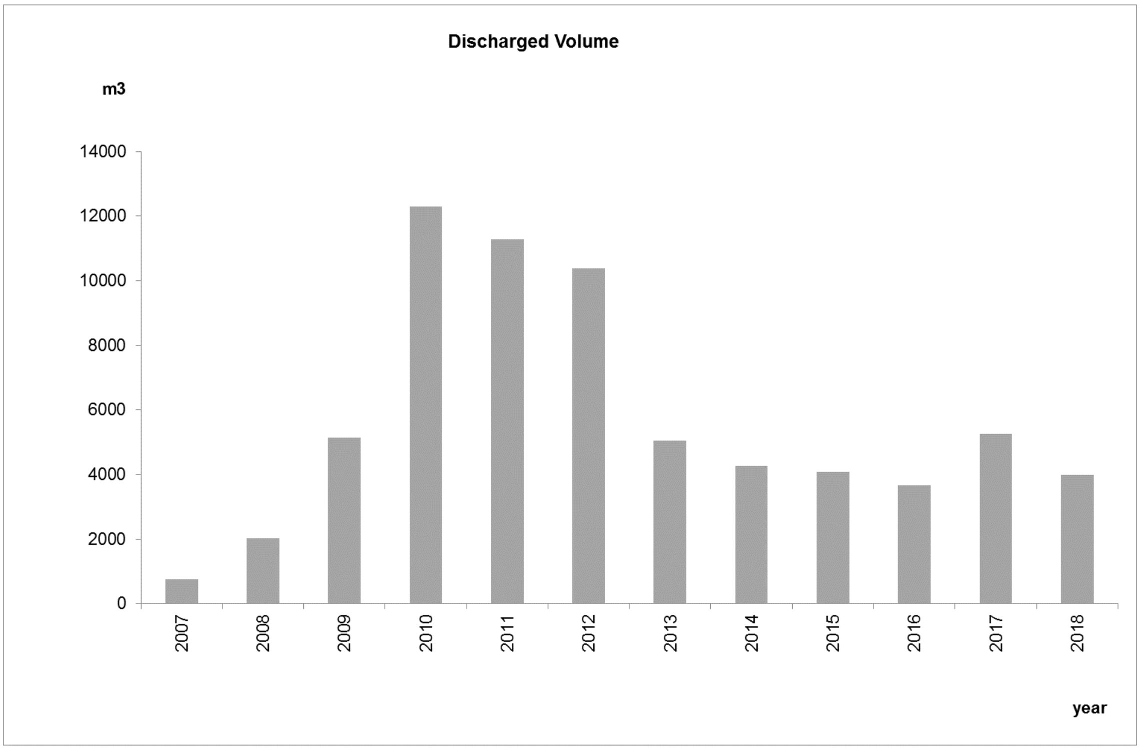

Figure 12 - Total volume discharge per year since 2007 until 2018.

CONCLUSION

The Portuguese Environment Agency, as the competent authority for the radiation protection, ensures the control of radioactive substances and the effective application of a clear policy under which the application of the Best Available Techniques and the Best Environmental Practices (BAT/BEP) are required at all levels. This policy follows closely the requirements and recommendations of competent international bodies and adopts several principles to ensure the application of the precautionary principle and the prevention of pollution.

Throughout the years 1999-2006 and again after 2014 (until the year of full stop in 2017) the absolute total activity, excluding tritium, in the liquid effluents released from the Portuguese Research Reactor (RPI) exhibits a slightly downward trend throughout the years doses to the environment and humans in the vicinity of the installations, representing a small percentage of the authorised limit.

Regarding the radiological environmental impact around the RPI for the 2010-2018 periods, the levels of radionuclides found in all the measured matrixes and exposure pathways have been lower than the limit levels approved in the license.

Taking into account liquid and gaseous effluents, the highest activity in the period of time considered in this report was 499 MBq in 2009, which is very close to the release limit.

From the evaluations of the BAT/BEP indicators for discharges, environmental impact and radiation doses to the public it is concluded that BAT is applied in the Portuguese Research Reactor.

REFERENCES

M.J. Madruga, F. Carvalho, M. Reis, N. Pinhão, J. Alves, J. Corisco, R. Trindade, J.M. Oliveira, A. Libânio, A. Mourato, G. Silva, L. Portugal, I. Lopes, L. Silva, J. Abrantes, L. Torres, M. Malta, A.R. Gomes, G. Carvalhal, H. Fonseca, J. Melo, M. Pereira, A. Batista. Programas de Monitorização Radiológica Ambiental (Ano 2007). Instituto Tecnológico e Nuclear. Unidade de Proteção e Segurança Radiológica. ISBN 978-972-8660-33-8.

M.J. Madruga, F. Carvalho, M. Reis, J. Alves, J. Corisco, R. Trindade, N. Pinhão, J.M. Oliveira, A. Libânio, A. Mourato, G. Silva, L. Portugal, L. Santos, I. Lopes, L. Silva, J. Abrantes, L. Torres, M. Malta, A.R. Gomes, G. Carvalhal, H. Fonseca, J. Melo, M. Pereira, A. Batista. Programas de Monitorização Radiológica Ambiental (Ano 2008). Instituto Tecnológico e Nuclear. Unidade de Proteção e Segurança Radiológica. ISBN 978-989-96542-0-4.

M.J. Madruga, F. Carvalho, M. Reis, J. Alves, J. Corisco, R. Trindade, I. Lopes, J. Abrantes, L. Silva, L. Torres, L. Portugal, M. Malta, A. Libânio, A. Mourato, G. Silva, J.M. Oliveira, L. Santos, A. Batista, A.R. Gomes, G. Carvalhal, H. Fonseca, J. Melo, M. Pereira. Programas de Monitorização Radiológica Ambiental (Ano 2009). Instituto Tecnológico e Nuclear. Unidade de Proteção e Segurança Radiológica. ISBN 978-989-96542-5-9.

M.J. Madruga, F. Carvalho, M. Reis, J. Alves, J. Corisco, R. Trindade, I. Lopes, J. Abrantes, J.M. Oliveira, L. Silva, L. Portugal, M. Malta, A. Libânio, A. Mourato, G. Silva, L. Santos, A. Batista, A.R. Gomes, E. Andrade, G. Carvalhal, J. Melo, M. Pereira. Programas de Monitorização Radiológica Ambiental (Ano 2010). Instituto Tecnológico e Nuclear. Unidade de Proteção e Segurança Radiológica. ISBN 978-989-96542-6-6.

M.J. Madruga, F. Carvalho, M. Reis, J. Alves, J. Corisco, I. Lopes, J. Abrantes, J.M. Oliveira, L. Silva, L. Portugal, M. Malta, Yuriy Romanets, A. Libânio, A. Mourato, G. Silva, A. Batista, A.R. Gomes, E. Andrade, G. Carvalhal, J. Melo, M. Pereira. Programas de Monitorização Radiológica Ambiental (Ano 2011). Instituto Superior Técnico, Laboratório de Proteção e Segurança Radiológica. ISBN 978-989-96542-7-3.

M.J. Madruga, F. Carvalho, M. Reis, J. Alves, J. Corisco, I. Lopes, J. Abrantes, J.M. Oliveira, L. Silva, L. Portugal, M. Malta, M. Santos, Y. Romanets, A. Libânio, A. Mourato, G. Silva, A. Batista, A.R. Gomes, E. Andrade, G. Carvalhal, M. Pereira. Programas de Monitorização Radiológica Ambiental (Ano 2012). Instituto Superior Técnico, Laboratório de Proteção e Segurança Radiológica. ISBN 978-989-96542-8-0.

M.J. Madruga, F. Carvalho, M. Reis, J. Alves, J. Corisco, I. Lopes, J. Abrantes, J.M. Oliveira, L. Silva, L. Portugal, M. Malta, M. Santos, Y. Romanets, A. Libânio, A. Mourato, G. Silva, A. Batista, A.R. Gomes, E. Andrade, G. Carvalhal, M. Pereira. Programas de Monitorização Radiológica Ambiental (Ano 2013). Instituto Superior Técnico, Laboratório de Proteção e Segurança Radiológica. ISBN 978-989-96542-9-7.

M.J. Madruga, F. Carvalho, M. Reis, J. Alves, J. Corisco, A. Batista, I. Lopes, J. Abrantes, J.M. Oliveira, L. Silva, L. Portugal, M. Malta, M. Santos, M. Pereira, Y. Romanets, A. Libânio, A. Mourato, G. Silva, A.R. Gomes, E. Andrade. Programas de Monitorização Radiológica Ambiental (Ano 2014). Instituto Superior Técnico, Laboratório de Proteção e Segurança Radiológica. ISBN 978-989-20-6528-1.

M.J. Madruga, F. Carvalho, M. Reis, J. Alves, J. Corisco, A. Batista, A. R. Gomes, I. Lopes, J. Abrantes, J.M. Oliveira, L. Silva, M. Malta, M. Santos, M. Pereira, P. Pereira, Y. Romanets, A. Libânio, A. Mourato, G. Silva, E. Andrade, J. Pereira. Programas de Monitorização Radiológica Ambiental (Ano 2015). Instituto Superior Técnico, Laboratório de Proteção e Segurança Radiológica. ISBN 978-989-99833-0-4.

M.J. Madruga, F. Carvalho, M. Reis, J. Alves, J. Corisco, A. Baptista, A. R. Gomes, E. Andrade, I. Lopes, J. Pereira, J. Abrantes, J.M. Oliveira, L. Silva, M. Malta, M. Santos, M. Pereira, P. Pereira, Y. Romanets, A. Libânio, A. Mourato, G. Silva. Programas de Monitorização Radiológica Ambiental (Ano 2016). Universidade de Lisboa, Instituto Superior Técnico, Laboratório de Proteção e Segurança Radiológica. ISBN 978-989-99833-1-1.

M.J. Madruga, F. Carvalho, M. Reis, J. Alves, J. Corisco, A. Baptista, A. R. Gomes, E. Andrade, J. Pereira, J. Abrantes, J.M. Oliveira, L. Silva, M. Malta, M. Santos, M. Pereira, P. Pereira, Y. Romanets, A. Libânio, A. Mourato, G. Silva. Programas de Monitorização Radiológica Ambiental (Ano 2017). Universidade de Lisboa, Instituto Superior Técnico, Laboratório de Proteção e Segurança Radiológica. ISBN 978-989-99833-2-8.

M.J. Madruga, F. Carvalho, M. Reis, J. Alves, J. Corisco, A. Batista, A. R. Gomes, E. Andrade, J. Pereira, J. Abrantes, J.M. Oliveira, M. Malta, M. Santos, M. Pereira, P. Pereira, Y. Romanets, A. Libânio, A. Mourato, G. Silva. Programas de Monitorização Radiológica Ambiental (Ano 2018). Universidade de Lisboa, Instituto Superior Técnico, Laboratório de Proteção e Segurança Radiológica. ISBN 978-989-99833-4-2.

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