IAEA
International Atomic Energy Agency
Atoms for Peace

INTEGRATED REVIEW SERVICE FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT, DECOMMISSIONING AND REMEDIATION (ARTEMIS)

MISSION

TO

LUXEMBOURG

LUXEMBOURG, THE GRAND DUCHY OF LUXEMBOURG

24 to 28 September 2018

DEPARTMENT OF NUCLEAR SAFETY AND SECURITY
DEPARTMENT OF NUCLEAR ENERGY

ARTEMIS

Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation

REPORT OF THE

INTEGRATED REVIEW SERVICE FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT, DECOMMISSIONING AND REMEDIATION (ARTEMIS)

MISSION

TO

LUXEMBOURG

REPORT OF THE

INTEGRATED REVIEW SERVICE FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT, DECOMMISSIONING AND REMEDIATION (ARTEMIS) MISSION

TO

LUXEMBOURG

Mission dates: *24 to 28 September 2018*
Location: *Luxembourg, the Grand Duchy of Luxembourg*
Organized by: *IAEA*

ARTEMIS REVIEW TEAM	
Vidas PAULIKAS	Team Leader (Lithuania)
Luis JOVA SED	Reviewer (Cuba)
Gerard BRUNO	IAEA Team Coordinator
Cathleen ROUGHAN	IAEA Deputy Team Coordinator
Kristina NUSSBAUM	IAEA Admin. Assistant

IAEA-2018

The number of recommendations, suggestions and good practices is in no way a measure of the status of the national infrastructure for nuclear and radiation safety. Comparisons of such numbers between ARTEMIS reports from different countries should not be attempted.

CONTENTS

EXECUTIVE SUMMARY

At the request of Luxembourg authorities, in particular the Ministry for Health of the Grand Duchy of Luxembourg, the International Atomic Energy Agency organized an Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) peer review mission. The objective of the ARTEMIS Peer Review Service is to provide independent expert opinion and advice on radioactive waste and spent nuclear fuel management, decommissioning and remediation, based upon the IAEA safety standards and technical guidance, as well as international good practice. Luxembourg requested this IAEA review to fulfil its obligations under Article 14.3 of the Council Directive 2011/70/Euratom of 19 July 2011 establishing a *Community Framework for the Responsible and Safe Management of Spent Fuel and Radioactive Waste* ("*Waste Directive*").

The review was performed by a team of two senior international experts in the field of decommissioning and radioactive waste and spent fuel management, from IAEA Member States, with IAEA staff providing coordination and administrative support. Subsequent to a preparatory meeting in January 2018, and the receipt and review of Advanced Reference Material third quarter of 2018, in September 2018 the ARTEMIS Peer Review team evaluated the overall Luxembourgish programme for the management of all types of radioactive waste.

Considering the very small amount of radioactive waste to manage in the country, Luxembourg has established a specific management programme as follows:

- storage for decay of short-lived radioactive materials and subsequent clearance,
- the storage of legacy radioactive waste in a dedicated facility located in the country prior to sending the waste to Belgium for the subsequent management steps and ultimately disposal,
- the direct transfer of the disused sealed radioactive sources from the licensee facilities to the Belgium authorities for subsequent management.

To implement such a strategy, a contractual agreement has been established in the 90's between Luxembourg and Belgium. The renewal of this agreement has recently been done for a period of 30 years and is now waiting for its ratification by Belgium.

The ARTEMIS team was impressed by the pragmatic approach that was adopted by the Luxembourg authorities to establish a radioactive waste management strategy commensurate with the types and inventory of radioactive waste to be managed.

However, noting that all the activities (regulatory and operational) in relation to the management of radioactive waste in the country are concentrated in a single authority - the Ministry of Health – the ARTEMIS team made the following four recommendations with the view to improve the safe management of radioactive waste in Luxembourg.

- The Ministry of Health should enhance the regulatory framework for the safe predisposal management of radioactive waste, the decommissioning of facilities and remediation activities in accordance with relevant IAEA safety standards.
- The Ministry of Health should establish a mechanism to ensure the effective independence of DRP as a regulatory authority from the operational radioactive waste management facility and activities.
- The Department of Radiation Protection should strengthen provisions for the authorization of all the radioactive waste management activities that are performed in the country, including those that are implemented by qualified foreign companies.

- The Government should establish and regularly update the national policy and strategy considering provisions for the management of radioactive waste generated by potential emergency situations or other new identified waste streams.

In addition, the ARTEMIS team provided the Luxembour authorities with the following two suggestions:

- The Department of Radiation Protection should consider further developing the safety provisions and procedures for establishing the safety case and safety assessment for facilities and activities in the predisposal management of radioactive waste.
- The Department of Radiation Protection should consider the need of increasing the number of staff devoted to fulfil the provided recommendations and suggestions including the radioactive waste management programme.

In summary, the Review Team considers that Luxembourg has established a good basis for the safe and responsible management of radioactive waste upon which further improvements can be considered for future implementation.

The Review Team is of the collective opinion that Luxembourg is in a good position to continue meeting high standards of safety for radioactive waste management in the country.

I. INTRODUCTION

At the request of Luxembourg authorities, in particular the Ministry for Health of the Grand Duchy of Luxembourg, the International Atomic Energy Agency organized an Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) peer review mission. The objective of the ARTEMIS Peer Review Service is to provide independent expert opinion and advice on radioactive waste and spent nuclear fuel management, decommissioning and remediation, based upon the IAEA safety standards and technical guidance, as well as international good practice. Luxembourg requested this IAEA review to fulfil its obligations under Article 14.3 of the Council Directive 2011/70/Euratom of 19 July 2011 establishing a *Community Framework for the Responsible and Safe Management of Spent Fuel and Radioactive Waste* ("*Waste Directive*").

The review was performed by a team of two senior international experts in the field of decommissioning and radioactive waste and spent fuel management, from IAEA Member States, with IAEA staff providing coordination and administrative support. Subsequent to a preparatory meeting in January 2018, and the receipt and review of Advanced Reference Material third quarter of 2018, in September 2018 the ARTEMIS team evaluated the overall Luxembourgish programme for the management of all types of radioactive waste.

II. OBJECTIVE AND SCOPE

The ARTEMIS review provided an independent international evaluation of the Radioactive Waste and Spent Fuel Management Programme of Luxembourg, requested in line with the obligations of the *Waste Directive*.

The ARTEMIS review, organized by the Department of Nuclear Safety and Security and the Department of Nuclear Energy of the IAEA, performed against the relevant IAEA Safety Standards and proven international practice and experiences with the combined expertise of the international peer review team selected by the IAEA.

The ARTEMIS review assessed, as requested by the *Waste Directive*, the overall programme for the management of all types of radioactive waste in Luxembourg.

An Integrated Regulatory Review Service (IRRS) mission at the request of the Government of Luxembourg was conducted from 11 to 20 June 2018. The IRRS team carried out the review in the following areas: responsibilities and functions of the government; the global nuclear safety regime; responsibilities and functions of the regulatory body; the management system of the regulatory body; the activities of the regulatory body including the authorization, review and assessment, inspection and enforcement processes; development and content of regulations and guides; emergency preparedness and response; occupational radiation protection, patient protection, transport, and interface of safety with security. The areas of "Control of discharges, materials for clearance and existing exposures situation", and "Environmental monitoring for public radiation protection", were not included in the scope of the mission. Luxembourg will consider including these areas in the follow-up mission. The IRRS mission included two policy issues discussions on the "Relation between a regulatory body and the licensees" and on the "Graded approach in the context of a small country". Thus ARTEMIS mission team will consider results of IRRS mission but those areas will not be discussed again.

III. BASIS FOR THE REVIEW

A) PREPARATORY WORK AND IAEA REVIEW TEAM

At the request of the Government of Luxembourg, a preparatory meeting for the ARTEMIS Review mission, was conducted on 18th January 2018. The preparatory meeting was carried out by the appointed Team Leader Mr Vidas Paulikas and the IAEA Team representative, Mr Gerard Bruno and the National Counterparts, Mr Patrick Majerus (Head of Radiation Protection Department), Mr Jean-Claude Thiry (Head of Non-medical applications unit) and Mr Thierry Bellot (Non-medical applications unit).

The ARTEMIS mission preparatory team had discussions regarding:

- the Terms of Reference for the ARTEMIS review of the Luxembourgish programme to fulfil obligations from article 14(3) of the *Waste Directive*; and
- the relevant detailed aspects for organization and conduct of the review.

IAEA staff presented the ARTEMIS principles, process and methodology. This was followed by a discussion on the work plan for the implementation of the ARTEMIS review in Luxembourg in September 2018.

Mr Patrick Majerus was appointed as the National Counterpart for the ARTEMIS mission and designated IAEA point of contact.

Luxembourg provided IAEA with the Advance Reference Material (ARM) for the review at the end of July 2018.

B) REFERENCES FOR THE REVIEW

The draft guidelines for the ARTEMIS review service and the responses to the self-assessment questionnaire were used as the basis for the review together with the ARM and materials presented during the mission and associated discussions. The complete list of IAEA publications used as the basis for this review is provided in Appendix D.

C) CONDUCT OF THE REVIEW

The initial ARTEMIS team meeting took place on Monday, 24 September 2018 in Luxembourg, directed by the ARTEMIS Team Leader Mr Vidas Paulikas and the ARTEMIS Team Coordinator Mr Gerard Bruno, Ms Cathleen Roughan supported their respective leads.

The ARTEMIS entrance meeting was held on Monday, 24 September 2018, with the participation of the relevant representatives of the Ministry of Health. Opening remarks were made by Mr Patrick Majerus (Head of Radiation Protection Department) and Mr Vidas Paulikas, ARTEMIS Team Leader. Mr Patrick Majerus gave an overview of the Luxembourgish context.

During the ARTEMIS mission, a review was conducted for all review topics within the agreed scope with the objective of providing Luxembourg authorities with recommendations and suggestions for improvement and, where appropriate, identifying good practice.

The ARTEMIS team performed its review according to the mission programme given in Appendix B.

The ARTEMIS exit meeting was held on Friday, 28 September 2018. Opening remarks were presented by Mr Xavier Poos, Deputy Director for Administration of the Directorate of Health, and were followed by the presentation of the results of the mission by the ARTEMIS Team Leader Mr Vidas Paulikas. Closing remarks were made by Mr Peter Johnston, Director of the Division of Radiation, Transport and Waste Safety, IAEA Department of Nuclear Safety and Security.

The ARTEMIS team suggests that Luxembourg requests a follow-up mission as recommended in the ARTEMIS guidelines.

An IAEA press release was issued.

1. NATIONAL POLICY AND FRAMEWORK FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT

1.1. NATIONAL POLICY

Luxembourg position

Luxembourg has no nuclear power plant, no other fuel cycle facility, no research reactor and no other facility generating radioactive substances. It further has no spent nuclear fuel and no high level radioactive waste on its territory.

In Luxembourg radioactive wastes are mainly arising from the use of radioactive sources in industry, medicine and to a small extent from the use in education and research. The Luxembourg Government takes the position that the option of a national treatment facility and of a disposal facility would be unrealistic, because it would not at all be commensurate with the radioactive waste activity and volume, which are very low. Therefore all disused sealed sources have to be returned to the country of origin and if this turns out to be impossible, to a foreign waste management facility.

The policy is based on the aim to avoid the production of radioactive waste, through the following provisions:

- return of disused sealed sources to the foreign supplier;
- replacement of radioactive sources by non-radioactive alternatives if available;
- minimization of the production of waste by the licensees;
- storage of short-lived radioactive waste on the user's premises until decay.

However, as it is never possible to obtain a zero waste status, some radioactive waste will still remain and needs to be taken care of. As these are very small quantities an agreement between Belgium and Luxembourg had existed since 1990, in which the Belgian Government accepted to manage the waste coming from the Grand Duchy of Luxembourg up to their disposal.

The national policy is part of the national programme for the management of radioactive waste, as required by the *Waste Directive*. It has been drafted by the Department of Radiation Protection (DRP) and approved by the Minister of Health in August 2015.

ARTEMIS observation

The National Policy on radioactive waste management is established and documented in the National Programme on Radioactive Waste Management. During the discussions it was emphasised that the fundamental principle of radioactive waste management in Luxembourg is based on the minimization of waste. For this purpose, any establishment has the obligation to seek all means to avoid the production of waste before starting a practice involving radioactive materials. As indicated in the Luxembourgish radioactive waste management programme, *"non-used radioactive substances"* must first be returned to a producing establishment or a recycling center before they can be considered, and subsequently declared as radioactive waste and therefore before they can be sent to a radioactive waste storage center.

Evaluation of the policy elements and the National Programme relating to its implementation, resources, responsibilities, framework for safety and public information and involvement was discussed in more detail during the mission and some findings are reported in subsequent sections of this report.

1.2. LEGAL, REGULATORY AND ORGANISATIONAL FRAMEWORK (PARTLY REFERRING TO IRRS)

Luxembourg position

The main pieces of legislation are the Law of 1963 on the Protection of the public against the hazards of ionizing radiation (LRP63) with its amendments and the Regulations of 2000 concerning the Protection of the population against the dangers arising from ionising radiation (RRP00). The Government is in the process of adopting a new law on radiation protection (PLRP) transposing the new Council Directive 2013/59/Euratom. This new law will replace LRP63 and the implementing regulations (PRRP) will replace RRP00.

The current legislation (RRP00) has a dedicated an article on radioactive waste (Art 2.19.2) and the new draft law (PLRP) has a similar article (141). It foresees that:

> *(1) Every establishment shall maintain the production of radioactive waste as low as reasonably achievable, in terms of activity and volume, by means of appropriate design measures and practices. operation and dismantling, including recycling and reuse of substances. Where radioactive waste practices are implemented in a systematic and planned manner, the facility must have a definitive disposal solution for these radioactive wastes.*
>
> *(2) The costs of managing radioactive waste are borne by those who produced the radioactive waste.*
>
> *(3) Every establishment manager shall provide evidence-based documentation of the decision-making process and all stages of radioactive waste management. It ensures the safe management of radioactive waste, including long-term, through passive safety devices, and implements measures in a graduated approach.*
>
> *(4) Every head of a radioactive waste management establishment shall periodically assess and verify, and continuously improve, to the extent reasonably practicable, the safety of radioactive waste management in a systematic and verifiable manner.*
>
> *The safety demonstration covers the establishment, operation, dismantling and, where appropriate, closure. The scope of the safety demonstration is related to the complexity of the operation and the magnitude of the risks associated with the radioactive waste.*
>
> *(5) The provisions of paragraphs 3 and 4 are part of integrated management systems, including a quality assurance, which give the necessary priority to safety for all radioactive waste management.*
>
> *(6) The Directorate of Health informs the public in the areas of its competence and publishes on its website the national plan for the management of radioactive waste referred to in Article 142.*

Furthermore, there is an additional focus on the management of disused sealed radioactive sources (DSRS) as this is the main identified path through which radioactive waste may arise in licensed practices in Luxembourg. For these, the licensee must include in the licence request a document from the supplier of the source stating that the source will be taken back once it gets disused.

Also, waste management facilities need a license, in which further conditions may be imposed concerning the provisions of any nature relevant to the management of radioactive waste.

As there are no large waste facilities in Luxembourg, and the waste is mainly arising through DSRS and legacy waste, the competences and skills required for radioactive waste management have the same general radiation protection requirements that apply to any licensee of practices using radioactive material. These are laid down in RRP00 and more specifically defined in PLRP: Title III, Chapter I.

The law of the Directorate of Health assigns the DRP as competent authority relating to ionizing and non-ionizing radiation, nuclear safety as well as the safety of management of radioactive waste.

Furthermore, RRP00: Art 10.4 assigns the responsibility to the Directorate of Health (and thus the DRP) to recover, manage and dispose of orphan sources. It also states that the State bears the costs of intervention relating to the recovery of orphan sources. These provisions are also included in PLRP: Art 133.

The development of the national radioactive waste management programme, as required by the *Waste Directive*, is under the responsibility of the Minister of Health. The requirements of this programme fully align with the *Waste Directive* provisions. The responsibility is laid down in RRP00: Art 10.5, and PLRP: Art 142.

Concerning licensing, inspections, review and assessment, the waste management facilities are part of the general license classification and treated as any other licensee of radioactive material. These procedures have been elaborated in the IRRS mission documents.

ARTEMIS observation

The overall governmental responsibilities and the regulatory framework were reviewed under the auspices of the IRRS mission hosted in 2018. Number of recommendations were provided to improve governmental infrastructure. ARTEMIS team was focused on legal, regulatory and organisational framework for radioactive waste management. It was noted that generally PRP00 and PLRP for radiation protection are only legal documents that set general requirements for authorisation and safety assessment of facilities and activities related to radioactive waste management. The ARTEMIS team considers that the regulatory requirements setting up provisions on predisposal management (GSR Part 5) and other relevant topics such as decommissioning (GSR Part 6) of facilities and remediation of activities are not detailed enough.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *It was noted that legal, organisational and regulatory framework is not fully developed especially aspects covering predisposal management of radioactive waste and all facilities and activities that deal with radioactive waste management. Furthermore, the DRP itself asked an independent expert to compare the storage provisions to legislation applicable. By the proposal of the expert where no prescriptive requirements were available he proposed to use requirements of Belgium.*	
(1)	**BASIS: GSR Part 5 Requirement 1 states that** *"The government shall provide for an appropriate national legal and regulatory framework within which radioactive waste management activities can be planned and safely carried out. This shall include the clear and unequivocal allocation of responsibilities, the securing of financial and other resources, and the provision of independent regulatory functions. Protection shall also be provided beyond national borders as appropriate and necessary for neighbouring States that may be affected. (See Ref. [5].)*
(2)	**BASIS: GSR Part 5 Requirement 3 states that "***The regulatory body shall establish the requirements for the development of radioactive waste management facilities and activities and shall set out procedures for meeting the requirements for the various stages of the licensing process. The regulatory body shall review and assess the safety case and the environmental impact assessment for radioactive waste management facilities and activities, as prepared by the operator both prior to authorization and periodically during operation. The regulatory body shall provide for the issuing, amending, suspension or revoking of licences, subject to any necessary conditions. The regulatory body shall carry out activities to verify that the operator meets these conditions. Enforcement actions shall be taken as necessary by the regulatory body in the event of deviations from, or non-compliance with, requirements and conditions. (See Ref. [5].)"*
(3)	**BASIS: GSR Part 5 Requirement 4 states that "***Operators shall be responsible for the safety of predisposal radioactive waste management facilities or activities. The operator shall carry out safety assessments and shall develop a safety case, and shall ensure that the necessary activities for siting, design, construction, commissioning, operation, shutdown and decommissioning are carried out in compliance with legal and regulatory requirements."*
R1	**Recommendation: The Ministry of Health should enhance the regulatory framework for the safe predisposal management of radioactive waste, the decommissioning of facilities and remediation activities in accordance with relevant IAEA safety standards.**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *DRP, belonging to the Ministry of Health is responsible for the operation of the centralized storage facility for the management of legacy radioactive waste including orphan sources. At the same time DRP is responsible for regulatory decisions on the safety of radioactive waste management, decommissioning and remediation taken by the Ministry of Health. According to the current organizational structure in place these responsibilities are covered by the same staff(s).*	
(1)	**BASIS: GSR Part 1 (Rev. 1) Requirement 4 states that "***The government shall ensure that the regulatory body is effectively independent in its safety related decision making and that it has functional separation from entities having responsibilities or interests that could unduly influence its decision making."*
(2)	**BASIS: GSR Part 1 (Rev. 1) Requirement 4. para. 2.8 states that** "*To be effectively independent from undue influences on its decision making, the regulatory body:* *(c) Shall be able to make independent regulatory judgements and regulatory decisions, at all stages in the lifetime of facilities and the duration of activities until release from regulatory control, under operational states and in accidents;* *(e) Shall be able to give independent advice and provide reports to government departments and governmental bodies on matters relating to the safety of facilities and activities. This includes access to the highest levels of government."*
(3)	**BASIS: GSR Part 1 (Rev.1) Requirement 4, para. 2.11 states that** *"In the event that a department or agency of government is itself an authorized party operating an authorized facility or facilities, or conducting authorized activities, the regulatory body shall be separate from, and effectively independent of, the authorized party."*
(4)	**BASIS: GSR Part 5 Requirement 1 states that** *"The government shall provide for an appropriate national legal and regulatory framework within which radioactive waste management activities can be planned and safely carried out. This shall include the clear and unequivocal allocation of responsibilities, the securing of financial and other resources, and the provision of independent regulatory functions…"*
R2	**Recommendation: The Ministry of Health should establish a mechanism to ensure the effective independence of DRP as a regulatory authority from the operational radioactive waste management facility and activities.**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *Some radioactive waste management activities (collection, packaging for transport of radioactive waste or disused sealed sources) are performed by foreign companies in the premises of the licensees, including the centralized storage facility. Some of these activities are planned and implemented without a specific authorization.*	
(1)	**BASIS: GSR Part 1 (Rev.1) Requirement 23 states that** *"Authorization by the regulatory body, including specification of the conditions necessary for safety, shall be a prerequisite for all those facilities and activities that are not either explicitly exempted or approved by means of a notification process."*
(2)	**BASIS: GSR Part 5 Requirement 3 states that** *"…The regulatory body shall review and assess the safety case and the environmental impact assessment for radioactive waste management facilities and activities, as prepared by the operator both prior to authorization and periodically during operation.…"*
(3)	**BASIS: GSR Part 5 Requirement 3 para 3.9 states that** "*The regulatory body has to carry out activities that are necessary to verify that requirements for safety and environmental protection are being met by the operator.…"*
R3	**Recommendation: DRP should strengthen provisions for the authorization of all the radioactive waste management activities that are performed in the country, including those that are implemented by qualified foreign companies.**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The storage facility Local de collecte de déchets radioactifs* (*LCDR) is under procedure of licencing. DRP contracted the outside service provider to develop the safety case and safety assessment of the LCDR for the licensing of the facility as a storage facility. DRP will subsequently review the safety case and safety assessment and will make a decision on authorization of the facility. This is complementary to Recommendation No. 1 on the independence of the regulatory authority. It was noted that currently there are no well-established safety provisions for development of the safety case and safety assessment.*	
(1)	**BASIS: GSR Part 1 (Rev.1) Requirement 23 para 4.16 states that** *"The management system shall maintain the efficiency and effectiveness of the regulatory body in discharging its responsibilities and performing its functions. This includes the promotion of enhancements in safety, and the fulfilment of its obligations in an appropriate, timely and cost effective manner so as to build confidence."*
(2)	**BASIS: GSR Part 5 Requirement 3 para 3.9 states that** "*The regulatory body has to carry out activities that are necessary to verify that requirements for safety and environmental protection are being met by the operator. These activities are required to be supported by an effective management system, including the establishment and maintenance of a strong safety culture."*
(3)	**BASIS: GSR Part 5 Requirement 3 para 3.8 states that "***To facilitate compliance with regulatory requirements, the regulatory body has to do the following:* *—Provide necessary guidance on the interpretation of national standards and regulatory requirements that takes into consideration the complexity of the operations and the magnitude of the hazards associated with the facility and operations;….* *…—Establish and clarify to the operator the processes used to evaluate safety and to review applications;* *—Document the procedures that operators are expected to follow in the licensing process;* *—Document the procedures that apply to the mechanisms for compliance verification and enforcement;…"*
S1	**Suggestion: DRP should consider further developing the safety provisions and procedures for establishing the safety case and safety assessment for facilities and activities in the predisposal management of radioactive waste.**

2. NATIONAL STRATEGY FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT

Luxembourg position

The implementation of the national strategy is laid down in the national waste programme. It describes management plans for all identified waste types, which are categorized as follows:

- Obsolete radioactive sources
- Secular sources
- Orphan radioactive sources
- Radioactive waste in detection portals
- Sources of the medical sector and laboratories
- Contaminated or irradiated equipment

Currently none of these waste types produce long-lived radioactive waste in a systematic and continuous manner. Also, there are no large storage inventories, as waste is send abroad regularly. Development of key drivers for implementation, timeframes for achievement, ways of managing programme delays are thus considered vain.

However, the national programme defines public campaigns aiming to retrieve legacy waste in different places (schools and in public households) as well as smoke detectors, in order to further reduce radioactive material eventually ending up as waste.

Implementation of the national programme is a continuous process. The campaigns defined in the national programme are ongoing. Currently the campaign of retrieving old radioactive sources and material from schools is still ongoing, although it should have been achieved by the end of 2017. As indicated by the Counterparts, work on a new legislation as well as IRRS and ARTEMIS missions kept the DRP very busy, finalisation has been postponed to end of 2018-mid 2019. The other campaigns will be organised consecutively.

The current national programme has been in force since 2015, and has not been subject to modifications since then. Before 2015, the national strategy was not formalized and there was no written plan.

ARTEMIS observation

The National programme on Radioactive waste management established for the nature and the amount of the radioactive waste in the country, indicates the regulatory control required, and considers relevant societal factors. It also foresees some measures to reduce the amount of radioactive waste. The Minister of Health establishes and ensures the implementation of a national programme in radioactive waste management. The Radiation Protection Division (DRP) of the Health Directorate acts as the competent authority in the field of safety of radioactive waste management. It holds a national register of all radioactive sources and radioactive waste under regulatory control. At the same time DRP is involved in the storage of radioactive waste and is the point of contact for any individuals or facility dealing with radioactive waste. It is responsible for the national inventory of radioactive waste that is under regulatory control and for the management of radioactive waste that is not under regulatory control and for which responsibility is not clearly defined.

The ARTEMIS Team was informed that public campaigns are planned to be organized promoting the need for recovering and the safe storage of any legacy waste or disused sealed source that may be in private or

institutional domains. The campaign to collect legacy waste from schools is near completion (it will last until all schools are notified about possibility to recover the radioactive sources). Campaign to retrieve items with some radioactivity requires communication with the public . The campaign will last until year 2029.

The ARTEMIS team was informed that licensing procedures for radioactive waste management facilities include the possibility and timeframe for the interested parties, including the public, to provide questions and comments. In addition to this Radioactive Waste Management Programme and related legal and regulatory framework are available in the public domain. As part of the public awareness programme, the Ministry of Health also makes available through its web site the Joint Convention Report and the received questions and provided answers.

The ARTEMIS team noted that the radioactive waste management strategy is mainly based on the following actions:

1. The licensee' contractual commitment to return any imported sealed radioactive source to the source provider.
2. To store for decay all the short lived radioactive materials mainly used in the medical practice.
3. To collect and store all legacy waste that did not have any management solution before.
4. To export the radioactive waste to Belgium in the framework of the bilateral agreement all collected radioactive waste that could not be cleared from regulatory control.

The ARTEMIS team was informed that clearance criteria and clearance levels are established in the regulatory framework. In the authorization of those institutions that use in their practices short lived radionuclides that can be discharge or cleared from the regulatory control conditions are provided by the DPR on which clearance levels need to be applied and how the control and record of these releases have to be performed. In the inspections the DPR inspectors used to control these procedures and records.

It is noted that the main component of the management of radioactive waste including disposal relies on the Agreement between Luxembourg and Belgium. However, the programme covers measures dealing with limited number of waste streams (legacy waste, disused sealed sources, cleared waste) and do not discuss strategies for management of radioactive waste that may occur, for example, following emergency situations, or other new streams in significant amount (NORM, contaminated metal in bulk) or strategies if final steps of management of radioactive waste foreseen in the programme would be changed. These considerations and potential solutions in the strategy may strengthen the public confidence in the radioactive waste management policy and strategy.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *The radioactive waste management policy and strategy cover mainly the management of the radioactive waste originated in normal practices and some legacy waste. But the radioactive waste management strategy does not cover any other radioactive waste that can be produced in another hypothetical situation in the country as for example radioactive waste that can be generated in an emergency situation in the country and other potentially identified radioactive waste streams.*	
(1)	**BASIS: GSR Part 5 Requirement 15 states that** *"…Storage is used to facilitate the subsequent step in radioactive waste management; to act as a buffer between and within waste management steps; to allow time for the decay of radionuclides prior to clearance or authorized discharge; or to hold waste generated in emergency situations pending decisions on its future management."*
(2)	**BASIS: GSR Part 5 Requirement 8 states that** *"All radioactive waste shall be identified and controlled. Radioactive waste arisings shall be kept to the minimum practicable."*
(3)	**BASIS: GSR Part 7 Requirement 3 states that** "*The government shall ensure that radioactive waste is managed safely and effectively in a nuclear or radiological emergency."*
(4)	**BASIS: GSR Part 7 Requirement 3 para 5.84 states that** *"The national policy and strategy for radioactive waste management shall apply for radioactive waste generated in a nuclear or radiological emergency, with account taken of paras 5.85 to 5.88."*
R4	**Recommendation: The Government should establish and regularly update the national policy and strategy considering provisions for the management of radioactive waste generated by potential emergency situations or other new identified waste streams.**

3. INVENTORY OF SPENT FUEL AND RADIOACTIVE WASTE

Luxembourg position

Radioactive waste is categorized by the half-life of the corresponding nuclides and whether the disused sources are sealed or unsealed. The classification system as recommended by the European Commission (Commission Recommendation 1999/669/EC, Euratom) is not used, as it does not present any practical advantage for Luxembourg. The classification of radioactive waste rests within the Belgian authorities, according to the Belgian classification systems, when treating and conditioning the waste.

According to RRP00: Art 2.17, the DRP is responsible for holding and keeping an inventory of all radioactive substances in Luxembourg, this includes radioactive waste.

The inventory is updated each time new waste is registered.

The national inventory contains the following information:

- Unique identification number
- Date registered
- Description
- Type
- Isotopic composition
- Total activity
- Dose rate on surface
- Contamination (Y/N)
- Holder including address and contact data
- Mass
- Identification of storage drum
- Location
- Status
- Comments

Import of radioactive waste is not practiced in Luxembourg. Information on waste exported (i.e. to Belgium) is kept as archived in the national inventory. All further treatment of waste resulting in changed data is no longer under national responsibility, and thus no longer tracked.

All radioactive material declared as waste, i.e. which will use one of the routes described in the national programme, is recorded in the national inventory.

DSRS are only recorded in the waste inventory when declared as radioactive waste, which can only be done when there is no possibility to return them to a supplier. Until then, DSRS are registered in the national source inventory.

Releases to the environment as well as short-lived waste in medical facilities are not registered in the national inventory.

The volume of conditioned waste transferred to Belgium so far amounts to a total of 0.51 m^3.

During the discussions, the counterparts indicated that the national inventory that was established for the national programme is presented in the Joint Convention Report (2017).

On the basis of a conservative estimate, the volume of conditioned waste is expected to be less than 2 m^3 in the next 30 years.

ARTEMIS observation

The ARTEMIS team noted that the inventory of radioactive waste in the country is kept updated and it is detailed.

At various steps in the predisposal management of radioactive waste, the radioactive waste shall be characterized and classified as a part of the interdependence requirement in accordance with safety provisions established or approved by the regulatory body. Currently the classification of radioactive waste is based on the origin of the waste, but also considers the activity and half-life of radionuclides. However, the documentation provided by Luxembourg doesn't describe how the classification is implemented. This comment is considered in the recommendation No. 1.

4. CONCEPTS, PLANS AND TECHNICAL SOLUTIONS FOR SPENT FUEL AND RADIOACTIVE WASTE MANAGEMENT

Luxembourg position

Radioactive waste arising from licensed facilities must be packed and stored by the facilities before transfer to Belgium. There is currently no licensee producing waste in a planned and systematic manner.

All other wastes arising in Luxembourg are to be considered as legacy waste, for which the DRP has the responsibility in collecting, storing the waste and organising the transfer to Belgium. For that purpose, the DRP operates a collection and storage centre (LCDR).

The LCDR is a single facility that is located on the territory of the City of Dudelange. The collected waste is mainly composed of disused sealed sources, for which no other recycling option is possible. Furthermore, waste volumes are very low and storage is for short time only, pending transfer to a foreign storage centre.

At the LCDR the radioactive waste is grouped according to its nature, isotopic composition and physical state. Disused sealed sources, which are mainly composed of smoke detectors, are collected until a sufficient quantity is reached. They are then packed for transport. Other waste, especially open sources and contaminated objects need to be immediately packed for transport. Packing is done by an external provider approved for that purpose and in accordance with the acceptance criteria of the recipient Belgium storage centre. Steps are taken to organize cross-border transfer and transport.

To summarize, only the collection part of the management chain of radioactive waste is done in Luxembourg. All further operations are to take place abroad via bilateral solutions. Hence, the management system is considered to be holistic, as all types of waste have a well-defined route in Luxembourg. There are no planned activities or further solution seeking for the safe management of radioactive waste in Luxembourg.

ARTEMIS observation

The ARTEMIS team was informed that packing is done by an external provider approved for that purpose and in accordance with the acceptance criteria of the recipient Belgium storage centre. These activities are sometimes performed without an authorization provided by the DRP. This was already recognized by the DRP prior to the mission. The ARTEMIS team was also informed that there are no safety or regulatory provisions for the development of initial decommissioning plan of any facility, even considering a graded approach. This comment is considered in the recommendation No. 3.

The ARTEMIS team also noted that the regulatory framework for the safe predisposal management of radioactive waste and decommissioning is not fully in compliance with the IAEA Safety Standards. This comment is considered in the recommendation No. 1.

5. SAFETY CASE AND SAFETY ASSESSMENT OF RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT ACTIVITIES AND FACILITIES

Luxembourg position

As prescribed by the *Waste Directive*, the RRP00 requires:

> *For establishments dealing with waste management:*
>
> *a. a safety demonstration covering the establishment, operation, dismantling and, where appropriate, closure as well as the post-closure phase of a disposal facility. The scope of the safety demonstration is related to the complexity of the operation and the magnitude of the risks associated with the radioactive waste.*
>
> *b. integrated management systems, including a quality assurance, which give the required priority to safety for all radioactive waste management.*
>
> *c. demonstration of adequate financial and human resources.*

Currently the only establishment to which this requirement is applicable to is the LCDR, which still only covers the collection of radioactive waste. There is no treatment or conditioning of waste taking place. In order to fully address the *Waste Directive* (and the RRP00) requirement, it was decided to mandate an external, foreign radiation protection expert to establish a safety case and safety assessment for this facility. His report was delivered to the DRP in May 2018, and the outcome will be part of the licensing process.

ARTEMIS observation

The ARTEMIS team noted from the information provided that the safety case and safety assessment for the LCDR was contracted to an external expert. The safety case was finished and now is in the process of public hearings as part of the authorization process.

The ARTEMIS team noted that the currently enforced regulatory provisions for the development of the safety case and safety assessment of predisposal facilities and activities are very concise and are not fully covering the relevant requirements and guidance of the IAEA Safety Standards in this area (GSR Part 5, GSR Part 4 and GSG-3). This comment is considered in the recommendation No. 1.

6. COST ESTIMATES AND FINANCING OF RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT

Luxembourg position

The costs resulting from the implementation of the national radioactive waste management programme is estimated from the expenditures of the last 15 years. There are two categories of expenditures: the costs of renting and operating the LCDR and the costs related to packaging, transport, storage and disposal in Belgium. Regarding the first point, the costs related to the local collection centre are fully included in the rental costs of the premises. As far as the second category of expenditure is concerned, shipping and storage costs in Belgium vary annually depending on the type of waste.

The estimation of the relative costs is based on an average of the last 15 years. Luxembourg considers that neither the volume nor the activity of the waste is likely to change significantly in the years to come.

The waste producer is responsible to cover all the costs for the safe management of waste including its disposal. The country covers the costs for waste for which no holder can be identified (orphan sources, but also legacy waste). All further collection campaigns are also financed by the country.

ARTEMIS observation

The ARTEMIS team noted from the presentations and discussions performed during the mission that the information provided in advance describes the real situation in the country. The ARTEMIS team does not provide any specific remark.

7. CAPACITY BUILDING FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT – EXPERTISE, TRAINING AND SKILLS

Luxembourg position

As the national programme mainly covers the collection of legacy waste and orphan sources, and all further steps in the management (conditioning, storage, disposal) are not done in Luxembourg, the national programme does not foresee a need for further development of skills.

Continuous training of DRP staff is performed through participation in international training courses and attendance in conferences and seminars.

Any potential new licensee in the field of radioactive waste management need to follow the general legislation and regulation concerning radiation protection. These foresee an RPO and an RPE with qualifications depending on the practice in question. RRP00 does not define exact criteria on training for these professionals; PLRP however issues more precise requirements on their qualification and training.

ARTEMIS observation

The ARTEMIS team was informed that according to the DRP's management plan there is a yearly review and assessment of the training needs of the personnel and plans are developed to fulfil these needs.

The ARTEMIS team noted that work load of DRP staff to fulfil the recommendations provided by different peer review missions will be increased for certain time.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation: *It was noted that the number of staffs devoted to the radioactive waste management activities is relatively small. The Ministry of Health recently received some peer review missions and the present ARTEMIS Mission which provided a number of recommendations that should be addressed. In addition to the updated legal framework, this fact may impose additional work load to DRP staff.*	
(1)	**BASIS: GSR Part 1 (Rev.1) Requirement 3 states that** *"The government, through the legal system, shall establish and maintain a regulatory body, and shall confer on it the legal authority and provide it with the competence and the resources necessary to fulfil its statutory obligation for the regulatory control of facilities and activities."*
(2)	**BASIS: GSR Part 5 Requirement 1 states that** "*The government shall provide for an appropriate national legal and regulatory framework within which radioactive waste management activities can be planned and safely carried out. This shall include the clear and unequivocal allocation of responsibilities, the securing of financial and other resources, and the provision of independent regulatory functions…."*
S2	**Suggestion: DRP should consider the need of increasing the number of staff devoted to fulfil the provided recommendations and suggestions including the radioactive waste management programme.**

APPENDIX A: TERMS OF REFERENCE

ARTEMIS Review of National Radioactive Waste and Spent Nuclear Fuel Management Programme of Luxembourg

Terms of Reference

1. Introduction

On 20th June 2017, the Minister of Health the Grand Duchy of Luxembourg requested the IAEA to organize and carry out, in the second half of 2018, preferably in September 2018, an Integrated Review Service for Radioactive Waste and Spent Fuel, Decommissioning and Remediation (ARTEMIS) mission in Luxembourg as required by the European 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* (hereinafter the Waste Directive). The review will focus on the radioactive waste and spent nuclear fuel management programme of the Grand Duchy of Luxembourg.

2. Objective

The ARTEMIS review will provide an independent international evaluation of the radioactive waste and spent fuel management programme of the Grand Duchy of Luxembourg, recognizing the elements required by the *Waste Directive*.

The review, organized in the IAEA by the Department of Nuclear Safety and Security and the Department of Nuclear Energy, will be performed on the basis of the relevant IAEA Safety Standards and proven international practice and experiences, with the combined expertise of the international peer review team selected by the IAEA.

The ARTEMIS review mission will take place in Luxembourg from 24th to 28th September 2018. The preparatory meeting for the ARTEMIS mission is scheduled 18th of January 2018.

3. Scope

The ARTEMIS review will assess, as requested by the Waste Directive, the overall programme for the management of all types of radioactive waste and spent fuel (if relevant) of the Grand Duchy of Luxembourg.

4. Basis for the review

The ARTEMIS review will be based on the relevant IAEA safety standards and proven international practice and experience, and will be conducted in accordance with the guidelines of the ARTEMIS review service available on the Global Nuclear Safety and Security Network (GNSSN) of the IAEA and provided to the Luxembourgish counterpart.

5. Reference material

The basis for the review will encompass all documentation submitted in line with the scope of the review by the Grand Duchy of Luxembourg according to the articles of the Waste Directive, the draft guidelines for the ARTEMIS review service and the responses to the ARTEMIS self-assessment questionnaire provided during the preparatory meeting to the Luxembourgish counterpart.

All documents for the purpose of the ARTEMIS review will have to be submitted in English.

6. Modus operandi

The National Counterpart is the Ministry of Health of the Grand Duchy of Luxembourg.

The coordination of the ARTEMIS review for the Grand Duchy of Luxembourg is ensured by Mr. Patrick Majerus, from the Ministry of Health.

The ARTEMIS mission will be organized according to the following milestones:

- Guidelines for ARTEMIS Review Service and self-assessment questionnaire: available to Luxembourg as of **January 2018**,
- Preparatory Meeting: **18th January 2018**, Luxembourg,
- Reception of English documents: at the latest 2 months before mission (including results of self-assessment) i.e. **24th July at the latest**,
- Questions/Additional information to the counterpart, following preliminary analysis by the experts: **20th August 2018**
- Detailed agenda of the review mission: **20th August 2018**
- Peer review mission: **24th-28th September 2018**
    - Arrival for **Monday 24th September 2018**: Team meeting of the experts
    - **Tuesday 25th September 2018 morning**: Entrance meeting
    - **Tuesday 25th September afternoon to Thursday 27th September 2018**: Interviews/presentations/discussions with/by counterpart(s) on the basis of a preliminary analysis and drafting of the report, including identification of any major missing elements from the national programme, recommendations, suggestions and good practices (if and where applicable)
    - **Thursday 27th September 2018**, **12:30** at the latest: Delivery of the draft report, including identification of any major missing elements from the national programme, recommendations, suggestions and good practices (if and where applicable)

- **Thursday 27th September 2018, 12:30 – 15:00**: Fact checking of draft report by counterpart(s)
- **Thursday 27th September 2018, 15:00 – 17:30**: Discussion with counterpart(s) on the draft report (after fact checking)
- **Friday 28th September 2018 morning**: Closure meeting – delivery of the draft report

- Finalization of the report: by the **15th November 2018.**

The working language of the mission will be English.

7. International peer review team

The IAEA will convene a team of international experts to perform the ARTEMIS review according to the agreed Terms of Reference. The team will consist of:

- 2 qualified and recognized international experts from government authorities, regulatory bodies, waste management organizations, and/or technical support organizations with experience in the safe management of radioactive waste and spent fuel;
- 2 IAEA staff for coordination and administrative assistance.

The peer review team will be led by a Team Leader from the review team as defined in the ARTEMIS guidelines.

The Team Leader for the mission is Vidas Paulikas, Deputy Head for Radiation Safety, State Nuclear Power Safety Inspectorate, Lithuania.

The IAEA will formally inform the National Counterpart regarding the composition of the proposed review team prior to conducting the mission.

The review mission may include the presence of observers, pending agreement by the National Counterpart in advance to the mission. It is expected that 2 potential observers will join this mission, to their own expenses:

- One from the European Commission,
- One from the next Member State having requested an ARTEMIS mission in relation to the obligations of the under the Waste Directive.

8. Reporting

The findings of the peer review will be documented in a final report that will contain proceedings, the recommendations, suggestions and if applicable, good practices. The report will reflect the collective views of the team members and not necessarily those of their respective organization or Member State or the IAEA.

9. Funding of the peer review

The peer review will be funded by the Grand Duchy of Luxembourg. The costs for the services will be limited to the travel costs and per diem of the peer review team (external experts and IAEA staff) in line with IAEA Financial Regulations and Rules.

The cost of the ARTEMIS peer review is currently estimated to the amount of XXX EUR to be paid to the IAEA as voluntary contribution before the start of the mission. Luxembourg is aware that the review cost includes 7% programme support costs. If the actual costs of the peer review exceed the initial voluntary contribution, The Grand Duchy of Luxembourg agrees to cover such additional costs to the IAEA. In the same way if the actual costs are inferior to the initial voluntary contribution, excess will be refund to the Grand Duchy of Luxembourg.

Luxembourg agrees with these Terms of Reference by accepting necessary arrangements.

APPENDIX B: MISSION PROGRAMME

ARTEMIS MISSION TO LUXEMBOURG PROGRAMME
24-28 September 2018

Monday, 24 September		
Ministère de la Santé, Allée Marconi. Villa Louvigny		
15:00 – 16:00	Opening General presentation	*Mr Vidas Paulikas (ARTEMIS Team Leader)* *Luxembourgish Counterparts: Mr Patrick Majerus (Head of Radiation Protection Department) Mr Jean-Claude Thiry (Head of Non-medical applications unit) Mr Thierry Bellot (Non-medical applications unit)* *Introduction of ARTEMIS team members and National Counterparts* *Presentation by Mr Patrick Majerus (Head of Radiation Protection Department)*
Hôtel Parc Belle Vue ; 5, Avenue Marie-Thérèse		
17:00 – 18:00	Team meeting	*ARTEMIS Team*

Tuesday, 25 September		
Ministère de la Santé, Allée Marconi. Villa Louvigny		
09:00 – 12:00	National Policy & Framework	*Presentation by Mr Jean-Claude Thiry (Head of Non-medical applications unit)* *Discussions (experts and counterparts)*

	National Strategy	
	Inventory	
	Concepts, plans and technical solutions	
	Safety case and safety assessment	
	Cost estimates and financing	
	Capacity building	
12:00 – 13:00	***LUNCH BREAK***	
13:00 – 17:00	Discussions on finalising the outcomes	*All participants*
19:00 – 21:00	Drafting of the outcomes and report	*ARTEMIS Team*

Wednesday, 26 September		
Ministère de la Santé		
09:00 – 10:00	Finalisation of Recommendations and Suggestions	*ARTEMIS Team*
10:00 – 11:00	Presentation of Recommendations and Suggestions to the Counterparts and discussions	*All participants*
12:00 – 13:00	***LUNCH BREAK***	
13:00 – 17:00	Writing of the draft report	*ARTEMIS Team*
	Submission of the draft report to the National Counterparts for fact checking	

Thursday, 27 September		
Ministère de la Santé		
09:00 – 10:00	Review of the draft report by National Counterparts	
10:00 – 11:00	Discussion on the draft report	*All participants*
11:00 – 12:30	Finalizing of the draft report	*ARTEMIS Team*
20:00 – 22:00	Hospitality event	*All participants*

Friday, 28 September		
Ministère de la Santé		
09:00 – 10:00	Closure meeting	*Mr Xavier Poos (Deputy Director for administration of the Directorate of Health)* *Mr Peter Johnston (Director, Division of Radiation, Transport and Waste Safety, IAEA)* *Presentation by Mr Vidas Paulikas ARTEMIS Team Leader* *All Participants*

APPENDIX C: RECOMMENDATIONS AND SUGGESTIONS

Area		R:Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
1.	**NATIONAL POLICY AND FRAMEWORK FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT**	R1	The Ministry of Health should enhance the regulatory framework for the safe predisposal management of radioactive waste, the decommissioning of facilities and remediation activities in accordance with relevant IAEA safety standards.
		R2	The Ministry of Health should establish a mechanism to ensure the effective independence of DRP as a regulatory authority from the operational radioactive waste management facility and activities.
		R3	DRP should strengthen provisions for the authorization of all the radioactive waste management activities that are performed in the country, including those that are implemented by qualified foreign companies.
		S1	DRP should consider further developing the safety provisions and procedures for establishing the safety case and safety assessment for facilities and activities in the predisposal management of radioactive waste.
2.	**NATIONAL STRATEGY FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT**	R4	The Government should establish and regularly update the national policy and strategy considering provisions for the management of radioactive waste generated by potential emergency situations or other new identified waste streams.

Area		R:Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
7.	**CAPACITY BUILDING FOR RADIOACTIVE WASTE AND SPENT FUEL MANAGEMENT – EXPERTISE, TRAINING AND SKILLS**	S2	DRP should consider the need of increasing the number of staff devoted to fulfil the provided recommendations and suggestions including the radioactive waste management programme.

APPENDIX D: LIST OF ACRONYMS USED IN THE TEXT

DRP – Department of Radiation Protection

DSRS – disused sealed radioactive sources

LCDR – Local de collecte de déchets radioactifs

APPENDIX E: IAEA REFERENCE MATERIAL USED FOR THE REVIEW

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Fundamental Safety Principles, Safety Fundamentals No. SF-1, Vienna (2006).

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Governmental, Legal and Regulatory Framework for Safety, General Safety Requirements No. GSR Part 1 (Rev. 1), Vienna (2016).

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Leadership and Management for Safety, General Safety Requirements No. GSR Part 2, IAEA, Vienna (2016).

[4] INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna (2014).

[5] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety Assessment for Facilities and Activities, IAEA Safety Standards Series No. GSR Part 4, IAEA, Vienna (2009).

[6] INTERNATIONAL ATOMIC ENERGY AGENCY, Predisposal Management of Radioactive Waste, IAEA Safety Standards Series No. GSR Part 5, IAEA, Vienna (2009).

[7] INTERNATIONAL ATOMIC ENERGY AGENCY, Decommissioning of Facilities, IAEA Safety Standards Series No. GSR Part 6, IAEA, Vienna (2014).

[8] INTERNATIONAL ATOMIC ENERGY AGENCY, Decommissioning of Facilities, IAEA Safety Standards Series No. GSR Part 6, IAEA, Vienna (2014).

[9] INTERNATIONAL ATOMIC ENERGY AGENCY, Disposal of Radioactive Waste, IAEA Safety Standards Series No. SSR 5, IAEA, Vienna (2011).

[10] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety of Nuclear Fuel Cycle Facilities, IAEA Safety Standards Series No. NS-R-5 Rev. 1, IAEA, Vienna (2014).

[11] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Energy Basic Principles, Nuclear Energy Series, NE-BP, Vienna (2008).

[12] INTERNATIONAL ATOMIC ENERGY AGENCY, Radioactive Waste Management and Decommissioning Objectives, Nuclear Energy Series, NW-O, Vienna (2011).

[13] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Fuel Cycle Objectives, Nuclear Energy Series, NF-O, Vienna (2013).

[14] INTERNATIONAL ATOMIC ENERGY AGENCY, Policies and Strategies for Radioactive Waste Management, IAEA Nuclear Energy Series No. NW-G-1.1, IAEA, Vienna (2009).

[15] INTERNATIONAL ATOMIC ENERGY AGENCY, Policies and Strategies for the Decommissioning of Nuclear and Radiological Facilities, IAEA Nuclear Energy Series No. NW-G-2.1, IAEA, Vienna (2012).

[16] INTERNATIONAL ATOMIC ENERGY AGENCY, Policy and Strategies for Environmental Remediation, IAEA Nuclear Energy Series No. NW-G-3.1, IAEA, Vienna (2015).

[17] INTERNATIONAL ATOMIC ENERGY AGENCY, Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, IAEA International Law Series No. 1, IAEA, Vienna (2006).

[18] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety Glossary – Terminology used in Nuclear Safety and Radiological Protection, IAEA, Vienna (2007).

[19] Official Journal of the European Union No. L 199/48 from 2nd Aug 2011, 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, Brussels (2011).