APPROVED
By Order of the Ministry of the Environment
"Approval of the National Radiation Safety Development Plan 2018–2027, the National Radon Action Plan, the National Action Plan for Radioactive Waste Management and the Implementation Plan of the National Radiation Safety Development Plan 2018–2027 for 2018–2021"

NATIONAL RADIATION SAFETY DEVELOPMENT PLAN 2018–2027

Tallinn 2019

Contents

Introduction

Ensuring radiation safety can be defined as the regulation of radiation practice for the protection of people and the environment, as well as the organisation of appropriate monitoring and supervision. In order to ensure radiation safety, it is necessary to determine which goals Estonia must achieve over a certain period of time, what to avoid, who and in what way and to what extent must protect the environment from the harmful effects of radiation or prevent activities harmful to human health. All these problems need integrated and rational solutions, and this requires a national radiation safety development plan.

Today, ensuring radiation safety has become part of the radiation safety quality system from merely monitoring compliance with the limits. Long-term planning of radiation safety is difficult, but indispensable in all areas of radiation practice. Radiation protection covers a wide range of activities: medicine, industry, preparedness for radiation events, environmental monitoring, etc. Continuous and balanced development in all these areas is essential to ensure radiation safety.

The most probable sources of radiation danger in Estonia are non-compliance with safety requirements when working with a radiation source and a traffic accident with a truck transporting radioactive substances. An emergency phase may emerge due to accidents at neighbouring nuclear power plants, accidents at radioactive waste management, as well as stolen or found radioactive substances. Radiation sources that are handled without a radiation practice licence or in violation of the conditions set out in the licence may also pose a threat. It must also be borne in mind that radiation sources can be used by terrorists in the manufacture of means of attack and the use of nuclear weapons in military conflict. Natural radiation, such as radionuclides in drinking water and the radon content of indoor air in buildings, must be taken into account when protecting people from excessive radiation.

Management of radiation safety requires a meaningful and purposeful approach. Radiation protection and the provision of radiation safety that depends on it is inherently an interdisciplinary activity – a complex of exact, natural and social sciences and their daily implementation. This development plan sets out the priorities for the development of radiation protection until 2027 and the measures and directions of action planned to achieve the set objectives.

The general objective of the development plan is to ensure radiation safety. The strategic sub-objectives of the development plan are the following:

- the functioning of the radiation safety infrastructure is improved;
- radiation safety awareness and competence building are ensured;
- the risks associated with radioactive waste and its management are reduced;
- preparedness for the prevention and resolution of radiation events is ensured;
- the risks from natural sources of radiation are reduced;
- the justified use of medical exposure and radiation safety are ensured.

Based on the sub-objectives, the areas of activity are the following: radiation training, radiation awareness, radioactive waste management, radiation events, natural radiation and medical exposure. The development of these areas will be important for at least the next ten years.

The development plan sets out six strategic sub-objectives, the achievement of which requires directions of action that have been planned in more detail. The determined courses of action form the basis for the preparation of the implementation plan for the specific period of the development plan. The development plan defines the roles of various institutions, the need and opportunities for financing the activity, as well as the indicators for the success of the activity.

The structure of the National Radiation Safety Development Plan is the following:

- the analysis of the current situation, including an analysis of the problems and opportunities available in the area of radiation protection (by area of activity);
- strategic sub-objectives of radiation protection, measurability of the achievement of the objective (indicators), methods of implementation of the activities necessary for the achievement of the objectives (directions of action);
- the organization of the implementation of the development plan, cooperation and division of roles between the various actors (also in different areas) to achieve radiation protection objectives (including the responsibilities of different institutions or their units, as well as cooperation and roles of different sectors), the organisation of evaluation of the effectiveness of radiation protection policy, the receipt of feedback on the effectiveness (including the quality of results) and effectiveness of the measures used to implement the development plan;
- the forecast of the sources and opportunities of financing required for the implementation of the development plan, implementation of the planned measures, and achievement of the set objectives.

The objective of the National Radiation Safety Development Plan (hereinafter “KORAK”) is to organise radiation protection over the next ten years in order to ensure optimal radiation safety, as well as operation and development of radiation protection in Estonia.

1. Relations with strategies and development plans in other areas and participating institutions

1.1. Relations with strategies and development plans in other areas

KORAK is based on the strategy "Sustainable Estonia 21" and represents a further development of the Estonian environmental strategy until 2030 in the area of radiation protection. The Environmental Strategy until 2030 addresses the need to take into account this radiation safety development plan.

In parallel, development plans and strategies in related areas will be taken into account: Development plan of the area of government of the Ministry of the Environment for 2019–2022 (ensuring radiation safety); Crisis management plan of the Ministry of the Environment (emergency preparedness); Population Health Development Plan 2009–2020 (health risk due to radon; a new development plan is being developed as of 2018); development plans of various medical specialties, including the Estonian Radiology for 2011–2020; Estonian Occupational Health Development Plan until 2020; Welfare Development Plan 2016–2023 (basics of labour policy and work environment); National Security Concept of Estonia (2010; prevention of emergencies and mitigation of consequences); and Internal Security Development Plan 2015–2020 (preparedness for radiation accidents; a new development plan is being developed as of 2018). The linking of these development plans and strategies to this development plan is addressed in the KORAK strategic environmental assessment report.

1.2. Relations with international law

Commitments to the development of radiation safety must take into account the commitments made both at the national and international levels. The main obligations relate to the Treaty on European Union and the Euratom Treaty.

The development plan is prepared on the basis of the following documents of international law:

- *Convention on Early Notification of a Nuclear Accident.* The Convention applies to any accident in which radioactive particles are or may be released into the environment and which cause or may result in the transboundary movement of radioactive effluents that could be of radiation safety significance to another State;
- *Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.* In accordance with the provisions of the Convention, the parties cooperate with each other and with the International Atomic Energy Agency (hereinafter "IAEA") to provide immediate assistance in the event of a nuclear accident or radiological emergency to reduce its consequences and protect life, property and the environment from radiation and radioactive effluents;
- *Convention on the Physical Protection of Nuclear Material and its amendment.* The Convention is applied to nuclear material used for peaceful purposes in its domestic use, storage and transfer, and to internationally transported nuclear material;
- *Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention*, establishing a link between the Vienna Convention and the Paris Convention by extending to each other the benefits of the special regime for civil liability for nuclear damage established by both Conventions;
- *Treaty on the Non-Proliferation of Nuclear Weapons and Agreement Between the Government of the Republic of Estonia and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation*

of Nuclear Weapons. Estonia undertakes to apply safeguards to all peaceful nuclear materials or special fissile materials in its territory so that such materials cannot be used in the manufacture of nuclear weapons or other nuclear explosive devices;

- *supplementary agreements to the Safeguards Agreement* determine the submission of nuclear material reports to the IAEA, the frequency of international inspections and the objects to be inspected;
- *Additional Protocol to the Agreement between Estonia and the IAEA on Safeguards in Relation to the Treaty on the Non-Proliferation of Nuclear Weapons* increases the amount of data to be provided to the IAEA and the rights of inspectors;
- *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.* The aim is to protect people and the environment from the dangers arising from the management of radioactive waste and spent fuel in the civilian areas by applying the principles of safe management;
- *Convention on Nuclear Safety and its Vienna Declaration.* The aim is to oblige countries with onshore nuclear installations to maintain a high level of safety by setting international standards to which they must adhere.

The development plan has been prepared on the basis of the following directives of the Council of the European Union:

- Directive 2013/59/Euratom, laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom;
- Directive 2006/117/Euratom, 20 November 2006, on the supervision and control of shipments of radioactive waste and spent fuel;
- Directive 2014/87/Euratom, 8 July 2014, amending Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations;
- Directive 2011/70/Euratom, 19 July 2011, establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste;
- Directive 2013/51/Euratom, 22 October 2013, laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption.

In addition to the above, the guidance materials of the European Commission, the IAEA and UNSCEAR have been followed in the preparation of the development plan.

1.3. Institutions participating in the completion of the development plan

1.3.1. Authors

The preparation of the development plan was organised by the Ministry of the Environment. The development plan was developed in cooperation with the Ministry of Social Affairs, the Ministry of Economic Affairs and Communications, the Ministry of the Interior, and the Ministry of Finance, and the agencies governed by the above-mentioned ministries were also involved: Environmental Board, Environmental Inspectorate, A.L.A.R.A. AS, Health Board, Tax and Customs Board, Police and Border Guard Board and Rescue Board.

In accordance with clause 33 (1) 1) of the Environmental Impact Assessment and Environmental Management System Act, a strategic environmental impact assessment of this development plan was carried out. This is mandatory as the activity planned under KORAK is expected to have a significant impact on the environment. In order to find a strategic environmental impact assessor, a public procurement was organised, as a result of which experts from Alkranel OÜ were selected as the impact assessors.

The KORAK strategic environmental assessment (hereinafter "SEA") focused the expected positive and negative impacts of the activities planned to implement the objectives of the development plan and their possible alternatives on human health and well-being, the environment and property by sub-objectives of the development plan. The assessment identified opportunities to avoid negative impacts and increase positive impacts, and if negative impacts could not be avoided, mitigation or remediation measures were proposed at the development plan level, and recommendations were made to mitigate the negative environmental impacts at the project level.

1.3.2. Persons and agencies who may have a legitimate interest in the development plan

In preparing the development plan, in addition to the authors, other persons and agencies who may have had a justified interest in the completion of the development plan were taken into account, and the involvement of various interest groups was considered important.

Section 26 of the Radiation Act establishes the purpose of the preparation of a national radiation safety development plan and section 37 of the Environmental Impact Assessment and Environmental Management System Act the strategic environmental assessment (SEA) programme and its section 41 the disclosure of the report. On the basis of the Environmental Impact Assessment and Environmental Management System Act, the SEA programme provides the agencies and persons, as well as non-governmental environmental organisations that must be involved.

In addition to the ministries involved in the preparation of the development plan and the agencies governed by them, the institutions whose opinion was sought on the development plan and the strategic environmental assessment are the following:

- Ministry of Culture;
- Ministry of Rural Affairs;
- Ministry of Education and Research;
- Association of Estonian Cities;
- Association of Municipalities of Estonia;
- Lääne-Harju Rural Municipal Government;
- Saue Rural Municipal Government;
- Saku Rural Municipal Government;
- Sillamäe Town Government;
- Veterinary and Food Board;
- Labour Inspectorate;
- Estonian Geological Service;
- Estonian Council of Environmental NGOs;
- Estonian Society of Radiology.

The proposals from interested parties and institutions are addressed in the chapter "Disclosure".

2. Radiation safety situation in Estonia in 2018

2.1. Ensuring radiation safety

2.1.1. Radiation safety infrastructure

In the area of the environment, codification of legislation took place in 2015 and 2016, and the General Part of the Environmental Code Act was modified in 2015 and 2016 with provisions on radiation. During the codification of environmental law, the new Radiation Act entered into force on 1 November 2016. The purpose of drafting the new consolidated text was primarily to harmonise the internal structure of the chapters. The content of the Act remained largely the same as under the 2004 Radiation Act, however, a number of substantive and fundamental changes were made. Along with the new Radiation Act, all sub-acts of the Act were re-established and renewed. The amendment to the Radiation Act, which entered into force on 15 August 2017, transposed into Estonian law Council Directive 2014/87/Euratom, 8 July 2014, amending Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations (hereinafter "Directive 2014/87/Euratom"). The amendment, which entered into force on 6 July 2018, transposed into Estonian law Council Directive 2013/59/Euratom, laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom (hereinafter "Directive 2013/59/Euratom").

With the amendments to the 2018 General Part of the Environmental Code Act and the Radiation Act, the requirement to submit an application for a digitally signed radiation practice licence and to formalise a radiation practice licence and the decision to issue it in digitally signed form through the Comprehensive Autonomous System for Environmental Decision-Making (hereinafter "KOTKAS") came into force. The amendments to the General Part of the Environmental Code Act and the Radiation Act were accompanied by the maintenance of a register of radiation sources and nuclear materials in KOTKAS. KOTKAS is a database aimed at simplifying the application for and processing of integrated environmental permits and radiation practice licences, the fulfilment of monitoring, reporting and other obligations related to the licence, and the storage, use and availability of collected data.

According to the Radiation Act, the Ministry of the Environment (hereinafter "KeM") organises radiation safety activities within its competence through the Environmental Inspectorate (hereinafter "KKI") and the Environmental Board (hereinafter "KeA"), involving other relevant agencies and taking into account, inter alia, industry-specific operational experiences, decision-making results, developments in relevant technology and research. While the task of KeM is to formulate a radiation safety policy and manage the area of government, the task of KKI and KeA is to implement this policy, fulfil the tasks provided by law, manage the radiation field and state supervision. Both agencies are also involved in drawing up policies, development plans and programmes. The fields of activity and tasks of KeM, KeA and KKI are provided in the statutes of these agencies[1]. The main task of KeA is to implement the state's environmental use, nature protection and radiation safety policy and to participate in the development of legislation in the respective area. The main task of KKI is to supervise the use of the natural environment and

[1] Regulation No 186 of the Government of the Republic of 10 December 2009 "Statutes of the Ministry of the Environment"; Regulation No 13 of the Minister of the Environment of 20 May 2014 "Statutes of the Environmental Board"; Regulation No 12 of the Minister of the Environment of 31 March 2009 "Statutes of the Environmental Inspectorate".

resources by processing both environmental misdemeanours and also crimes from 2011. Both institutions are involved in the performance of crisis management tasks. The following ministries and their subdivisions are involved in ensuring radiation safety:

1) The Ministry of the Interior organises activities related to the area of internal security, public order, border guard, rescue, emergency alerts and crisis management, and coordinates the participation of its subordinate agencies (Alarm Centre, Rescue Board, Police and Border Guard Board, Security Police Board) in radiation events;
2) The Ministry of Economic Affairs and Communications organises activities related to, inter alia, energy, housing, construction and transport (including transport infrastructure, transportation, transit, logistics and public transport). From the perspective of radiation safety, it is important to minimise the risks arising from natural radiation through the requirements for the planning, design, and construction of buildings. The subordinate agencies of the ministry that are involved in ensuring radiation safety are the state-owned public limited company A.L.A.R.A., the Road Administration and the Estonian Geological Service. The ministry is responsible for organising the interim and final storage of radioactive waste. A.L.A.R.A. AS is engaged in radioactive waste management and its intermediate storage. The Road Administration accepts and issues a driver training certificate in accordance with the European Agreement concerning the International Carriage of Dangerous Goods by Road (hereinafter “ADR”) (including Class 7 Dangerous Goods – Radioactive Material) and performs other operations in accordance with the requirements of ADR. The Estonian Geological Service is engaged in radon studies. The ministry coordinates the development of the energy sector, including the use of nuclear energy;
3) The Ministry of Social Affairs is responsible for, inter alia, protecting public health and organising medical care. The subordinate agencies of the ministry involved in ensuring radiation safety are the Health Board and the Labour Inspectorate. The Health Board analyses the information collected on the quality of drinking water in the course of monitoring and carries out risk assessments of health hazards, market supervision of medical devices, organises activities related to medical exposure within the competence of the board, as well as the assessment of the competence of health professionals and health care providers, coordinates the quality of health care services and provides opinions and assessments in this regard; maintains a state register of health care professionals, organises emergency preparedness and settlement of an emergency situation, and the continuity of vital services within the limits of its competence. The Labour Inspectorate monitors the measurement of the radon content of the air in the work premises;
4) The area of government of the Ministry of Finance includes, inter alia, the planning and implementation of customs policy. The Tax and Customs Board is involved in ensuring radiation safety, which inspects goods transported across the border and manages a radiation monitoring network at border crossing points to detect radioactive materials in the goods.
5) The subordinate of the Ministry of Rural Affairs, Veterinary and Food Board, which is involved in ensuring the radiation safety, carries out monitoring of agricultural products and supervision activities related to food safety.

On 28 September 2018, the Government of the Republic initiated the draft Act amending the Government of the Republic Act and other legislation (merging the Environmental Board and the Environmental Inspectorate[2]. The Ministry of Finance has also submitted a recommendation to KeM for the establishment of a joint environmental agency in the analysis of state tasks[3]

[2] http://eelnoud.valitsus.ee/main#FryQJSX6.
[3] Analysis of state tasks (Ministry of Finance, May 2016).

prepared in 2016, and in the comments of the follow-up audit of hazardous and radioactive waste management[4] in 2018. According to the explanatory memorandum to the draft Act, the merging of KeA and KKI would be based on the more general principle of state reform, which is to reduce duplication in state agencies, reduce the number of administrative agencies and improve the quality and availability of public services. The main tasks of KeA and KKI partially overlap. The roles of KKI and KeA also partially overlap in the performance of crisis management tasks, which does not facilitate the resolution of crisis cases.

The joined agency would merge the main functions of KeA and KKI, while the main tasks of both agencies would remain valid as before. The name of the joint agency would be the Environmental Board, which is general enough to cover the scope and nature of all the tasks of the agency. In the area of radiation, the establishment of a joint agency should provide for the possibility of appointing radiation inspectors and providing them with sectoral training. Specialisation will ensure more effective and high-quality supervision in the area of radiation and increase the radiation competence of inspectors.

In order to maintain the quality of the measurement results of radiation measuring devices used to ensure radiation safety, it is necessary to regularly inspect (calibrate) the measuring devices. Today, there is no possibility to check these measuring devices in Estonia, which is why it is necessary to increase the possibilities of calibrating the devices. To this end, a Secondary Standard Dosimetry Laboratory (SSDL) must be established in accordance with international requirements, where reliable, fast and high-quality calibration of radiation measuring equipment used for monitoring, resolution of radiation events and various radiation practices takes place, which improves the quality of measurement results and, therefore, reduces the radiation risk to people and the environment.

In July 2015, the Minister of the Environment issued an order to approve a national action plan for radioactive waste management (see Annex 1), the need for which arose from the KORAK 2008–2017 approved in 2008 (hereinafter "KORAK 2008–2017") and its implementation plan. In 2011, Council Directive 2011/70/Euratom, 19 July 2011, establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste (hereinafter "Directive 2011/70/Euratom"), which set out more specific requirements for the preparation of a national radioactive waste management action plan. Therefore, the draft action plan was also updated in accordance with the requirements of the guidance on the implementation of Directive 2011/70/Euratom. Member States were required to submit a first report to the Commission on the implementation of the Directive by 23 August 2015, at the latest, and every three years thereafter, on the basis of the review and reporting requirements of the Joint Convention. Based on the Radiation Act, action plans may be prepared for the areas of KORAK in order to implement the development plan or to achieve the objectives of organising and improving radiation safety. A reviewed national action plan for radioactive waste management, annexed to KORAK and updated as needed, is represented under this KORAK in the area of radioactive waste management. The objectives of the National Action Plan for Radioactive Waste Management are taken into account in the KORAK implementation plan. According to the radioactive waste management policy presented in the National Action Plan for Radioactive Waste Management, a radioactive waste disposal site must be established in Estonia by 2040. From 2014–2015, international experts decommissioned the reactor sections of the Paldiski nuclear site and carried out preliminary studies for the construction of a final radioactive waste storage site[5] (hereinafter "preliminary studies for the final storage

[4] https://www.riigikontroll.ee/Suhtedavalikkusega/Pressiteated/tabid/168/557GetPage/1/557Year/-1/ItemId/1008/amid/557/language/et-EE/Default.aspx.

[5] http://alara.ee/wp-content/uploads/2018/08/kodulehtPaldiskieeluuringudlopparuanne.pdf.

site”). At the cabinet meeting on 28 April 2016, the Government of the Republic adopted a decision in principle to establish a radioactive waste disposal site in Estonia. The National Action Plan for Radioactive Waste Management also addresses the policy on the management of residues containing naturally occurring radioactive substances (NORM residues) and waste (NORM waste).

The Radiation Act establishes the obligation to conduct a national radiation safety audit in Estonia once every ten years. This requirement derives from Directive 2014/87/Euratom. A national radiation safety audit is an audit conducted for the purpose of enhancing radiation safety, in the course of which the legal and organisational arrangements of the state radiation safety and the agencies ensuring radiation and nuclear safety are assessed. The audit will involve internationally recognised radiation experts. The results of the expert opinions will be communicated to the Member States and the European Commission. Such a service can be commissioned by states from the International Atomic Energy Agency (IAEA) – the Integrated Regulatory Review Service mission (hereinafter “IRRS mission”). An ex-post audit with the participation of internationally recognised radiation experts must be carried out after four years, at the latest, in order to assess the fulfilment of the corrective needs identified during the IRRS mission.

The IRRS mission took place in Estonia from 4–14 September 2016. The mission assessed the state’s legal and organisational framework for radiation safety and the competent regulatory agencies, as well as inspections. A report on the results of the IRRS mission[6] was prepared, in which recommendations and suggestions for the improvement of the national radiation safety organisation are made. Although the tasks of the agencies involved in radiation safety activities have been more specified compared to the implementation period of the KORAK 2008–2017, international experts still noted in the report that there is an overlap of regulatory functions in ensuring radiation safety. There was also reference to the lack of cooperation and exchange of information between the authorities involved in ensuring radiation safety in some areas (e.g. organisation of supervision of health care providers, exchange of information on the transport of radioactive materials). Furthermore, it was considered necessary to specify and update the use of radiation in different areas with measures to ensure radiation safety, taking into account the specifics of the area. Although the vast majority of recommendations and proposals are written in the Radiation Act, some of them still need more in-depth analysis. These are provided in the relevant chapters of this KORAK.

The follow-up mission of the IRRS mission took place in Estonia from 3–9 March 2019. The team of IAEA experts who stayed in Estonia for a week gave a positive assessment of Estonia’s nuclear and radiation safety measures – compared to 2016, the situation has improved. The national radiation safety policy and strategy have been updated and legislation has been aligned with IAEA standards. Radiation safety monitoring has also improved. It was highlighted that Estonia must create a sustainable system for the training of radiation safety specialists and update legislation with provisions on the final storage of radioactive waste.

The next national radiation safety audit is due in 2026 and preparations will start in 2025, at the latest. The preparation process for the IRRS mission is organised by KeM and involves KeA and KKI, as well as the Ministry of Social Affairs and the Health Board and other ministries and agencies involved in ensuring radiation safety, if necessary.

Council Directive 2011/70/Euratom, establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste, obliges Estonia to assess the national radiation safety organisation, the competent regulatory agency, the national programme and its

[6] https://www.envir.ee/sites/default/files/irrs_estonia_final_report_2016-11-10_.pdf.

implementation at least once every ten years. The assessment service can be commissioned from the IAEA as the so-called ARTEMIS mission (Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation Mission). A follow-up mission will be carried out in two to four years to assess the need for remediation identified during the ARTEMIS mission, however, the need will depend on the actual situation or will be agreed in the terms of reference of the ARTEMIS mission.

The first ARTEMIS mission in Estonia took place from 24 March–1 April 2019, and in the course of it, international experts assessed the national organisation of radioactive waste management in Estonia. International experts highlighted that with its generation of radioactive waste at very low incidence, Estonia has been able to create complete solutions for its management. The conclusions of the audit provided recommendations for planning the activities necessary for the construction of a radioactive waste disposal site in Estonia by 2040. It was also emphasised that in addition to the Ministry of the Environment, other relevant ministries must take responsibility for organising the management of radioactive waste.

Based on the Radiation Act, action plans may be prepared for the areas of KORAK in order to implement the development plan or to achieve the objectives of organising and improving radiation safety. As part of this KORAK, a national radon action plan is being prepared under the area of natural radiation, which has been annexed to KORAK. The need to establish an action plan stems from Article 103 of Directive 2013/59/Euratom. The Directive obliges Member States to adopt a national action plan for the long-term risk of radon exposure from residential sources, such as soil, building materials or water, in residential, public buildings and workplaces. The preparation of the national radon action plan is coordinated by KeM in cooperation with KeA. The action plan is coordinated with the Ministry of Social Affairs, the Ministry of Economic Affairs and Communications, the Ministry of Education and Research and the Ministry of Finance. The action plan is regularly updated as required and its objectives are taken into account when preparing the KORAK implementation plans.

2.1.2. Radiation practice

Radiation practice requires a radiation practice licence issued by the Environmental Board, the fulfilment of the conditions of which is inspected by the Environmental Inspectorate.

Approximately 630 radiation practice licences have been issued in Estonia. Radiation sources are used by industrial and service companies, healthcare and veterinary service providers, scientific and research institutions and government agencies. A radiation practice licence is required for the management of radioactive waste and related activities, the transport, import, export and transit of radioactive materials, as well as the provision of installation, maintenance and repair services for a radiation source. The majority of radiation licences (approximately 75%) have been granted to healthcare providers, followed by industrial companies and veterinary providers in terms of the number of licences. The areas of use of the radiation source have not changed compared to the validity period of the KORAK 2008–2017. The introduction of new radiation sources is not planned in the near future either – it depends on changes in international legislation as well as significant economic developments (new technologies).

The most important change in the area of radiation is the adoption of the decision to establish a final disposal site by the Government of the Republic in 2016. The radioactive waste final disposal site must be established in Estonia by 2040. According to the summary in the National Action Plan for Radioactive Waste Management and the preliminary studies for the final storage site, the construction of the final storage site must be preceded by a thorough analysis and updating of legislation, as the current legal framework is not sufficient for the construction of a final storage site. It is also noted that in addition to the Radiation Act and the regulations established on the basis thereof, the legislation on the design and construction of buildings must be amended in order to lay down the requirements for the construction of a final storage site. Based on the Radiation Act, the provision of public procedure must be applied to the application for a radiation practice licence for the final storage of radioactive waste and based on the Environmental Impact Assessment and Environmental Management System Act, this activity has a significant environmental impact, which must be assessed in order to identify the potential impact of the proposed activity and to inform the public. With the final storage of radioactive waste, Estonia undertakes for the first time the final storage of radioactive waste, with which Estonia has no previous experience. Therefore, it is reasonable for Estonia to develop the legal norms in this area on a project basis by outsourcing the service.

In accordance to the Radiation Act, radiation practice is classified as low-level, moderate and high-risk activities on the basis of the annual effective dose received by an exposed worker. In addition, high-risk radiation practice is classified, regardless of the annual effective dose received by the exposed worker, including the use of a high-activity radiation source and the intermediate and final storage of radioactive waste. The entry into force of the new Radiation Act in 2016 was accompanied by a significant change, according to which a radiation practice licence is granted for an indefinite period for low-risk radiation practice. Previously, all radiation licences were valid for up to five years, regardless of the level of danger. Moderate and high-risk radiation practice is still granted a radiation practice licence for up to five years. Low-risk radiation licences account for approximately 73%, moderate-risk radiation licences for 26% and high-risk radiation licences for 1% of the total number of licences. Licences issued for low-risk radiation practice before the new Radiation Act are valid until the expiry of the licence. By the end of 2021, at the latest, the radiation practice licences issued for low-risk radiation practice before the new Radiation Act will expire, and since then all low-risk radiation practices will be regulated by an open-ended radiation practice licence. Although licences for low-risk radiation practice are granted for an indefinite period, these are supervised on the same basis as for high and moderate-risk radiation practices established in the Radiation Act.

From the first half of 2018, applications for radiation practice licences will be submitted, processed and issued through KOTKAS, and the register of radiation sources and nuclear materials will also be maintained in the same database. Previously, the application for and processing of a radiation practice licence, monitoring related to the licence, reporting and fulfilment of other obligations related to the licence took place in the KeA document management system. Data could be submitted both electronically and on paper. The grant of an emergency licence was also formalised in the KeA document management system, but the licence was issued on paper. There were separate registers for radiation practice licences, as well as for radiation sources and nuclear materials, in which data was entered manually. Data is entered and stored digitally in KOTKAS. Both the application and the radiation practice licence are prepared and signed digitally and forwarded via KOTKAS. Applying for and processing of a radiation practice licence, monitoring related to the licence, reporting and fulfilling other obligations related to the licence, as well as storing, using and making available the collected data is much easier than before. Forms and instructions are built into the system, and data is collected from several registers (applications for radiation practice licences, radiation practice licences, radiation sources). All valid radiation licences have been transferred to KOTKAS. This ensures that monitoring and other data related to the licence, as well as data related to the modification of the licence, are in a single system and that information on the activities related to a specific radiation practice licence is available in a compact way. The development of KOTKAS is an ongoing process.

The new Radiation Act established the definition of the category of a radioactive source and introduced a regulation describing, inter alia, the categories of radioactive sources and the requirements for the physical protection of a radiation source, depending on the category of the radiation source. Internationally, increasing attention is being paid to the establishment and implementation of security requirements for the physical protection of radioactive material. Therefore, development work is being carried out to develop an alternative to the use of radioactive material, such as the replacement of a device containin radioactive material with an X-ray device. In the near future, it may be envisaged to replace some equipment containing radioactive material with X-ray devices.

The amendment to the Radiation Act, which entered into force in 2018, addresses activities related to natural radiation sources in much more detail than before, listing activities where natural sources may cause higher radiation exposure to workers or residents than the effective dose limit established under the Radiation Act. Operations involving natural sources may involve the generation of natural NORM residues or NORM waste. The Environmental Board also has the right to demand a radiation safety assessment from the employer on the basis of the Radiation Act, in which the possibilities of generation and handling of NORM residues or NORM waste have been assessed. Operations referred to in the Radiation Act, for which it would also be necessary to assess the possible generation of NORM residues/waste and, if necessary, their treatment possibilities, generally require other environmental permit. In order to prevent situations where licences are planned and applied for activities which may involve a risk of NORM residues/waste, but which may not be assessed during the planning of activities, it is necessary to provide at the statutory level that in the event of operations related to natural radiation sources listed in the Radiation Act in the course of applying for a licence related to the use of the environment, a radiation safety assessment must be submitted in addition to other documents. This would, inter alia, provide an overview of the material contaminated with natural radionuclides resulting from the planned activities. The radiation safety assessment would allow deciding on the need to monitor the radioactivity of the technology and/or material, the conditions for which would be specified in the licence for the use of the environment (environmental permit other than radiation practice licence, integrated environmental permit or other permit). In order to ensure more effective preventive control over the possible prevention/reduction of NORM residues and NORM waste, it is necessary to establish in the General Part of the Environmental Code Act a requirement to submit a radiation safety assessment for the operations specified in the Radiation Act when applying for an environmental permit. The amendment to the General Part of the Environmental Code Act would, inter alia, improve the work between different content departments of KeA. The IRRS mission also highlighted the lack of control over the possible generation of NORM residues and NORM waste and the lack of a strategy for the handling of NORM materials. The IRRS experts recommended that issues related to NORM residues and NORM waste management be included in the National Action Plan for Radioactive Waste Management.

In order to better ensure radiation safety, KeA has highlighted in its development plan 2019–2022 the need to change the bases for determining the hazard levels of radiation practice. According to the Radiation Act, the determination of the hazard levels of radiation practice is limited to the assessment of the annual dose received by an exposed worker from radiation practice and does not take into account the risks associated with the radiation source itself. When determining the levels of radiation practice, the effects of different components (facility, premises, radiation source, radiation dose) must be taken into account. In order to better determine the danger levels of radiation practice, the radiation practice performed in the state and the radiation sources used in radiation practice are analysed, based on international best practices. The analysis uses, inter alia, the IAEA radioactive material classification guides, which outline the potential health risks in the event of a radioactive accident. The redefined levels of radiation exposure resulting from the analysis based on these guidelines will allow graded approach for implementation of radiation safety requirements. The IRRS mission noted that the graded approach of radiation safety requirements based on the specifics of radiation practice and their potential impact is not always ensured. It also indicated that the use of a radioactive substance is not based on the IAEA classification system for radioactive material when assessing its potential impact. In order to change the bases for determining the hazard levels of radiation practice, it is necessary to amend the Radiation Act and its by-laws.

The Radiation Act defines the responsibility of the holder of a radiation practice licence. The holder of a radiation practice licence is responsible for fulfilling the obligations established in the Radiation Act and the conditions of the licence in order to ensure radiation safety and the protection of workers in the event of a radiation situation related to any radiation source in the holder's possession or practice. The IRRS mission highlighted that although the responsibilities of the holder of a radiation practice licence are clearly defined, there is no requirement that prohibits the holder of a radiation practice licence from offering compensation to an exposed worker instead of implementing protection and safety measures. The compensation may be the receipt of an additional remuneration, special insurance, working time or additional leave. If, for example, the medical examination shows that the employee may no longer continue working for health reasons, the employer will do everything possible to provide the employee with a suitable alternative employment opportunity.

Based on the Radiation Act, an applicant for a radiation practice licence must, inter alia, submit a safe inclusion plan of radiation source, which provides information on the procedures for decommissioning the radiation source. The Radiation Act provides a definition of "decommissioning" – all activities performed and measures taken to terminate, in part or in full, the operation of any facility which poses a radiation threat to individuals, including the deactivating and full or partial dismantling of the facility. Decommissioning is considered as a radiation practice in connection with a nuclear fuel cycle facility. If the decommissioning is related to the cessation of radiation practice, the safe inclusion of the radiation source does not necessarily mean the cessation of radiation practice. If the safe inclusion of the radiation source has been completed, a new radiation source can be introduced in the same place. The cessation of radiation practice is usually followed by a transitional period, which is a preparation period for decommissioning, the purpose of which is to exempt the location of the radiation practice from the application of radiation safety requirements. For decommissioning, a plan is presented with three stages, depending on the company's intentions: the initial decommissioning plan; updating of the plan due to changes in equipment and technology or the occurrence of unforeseen situations and data on the operation of the facility, including accidents, as well as amendments to legislation; the final decommissioning plan. In order to establish radiation safety requirements and, if necessary, to provide additional definitions in the Radiation Act for decommissioning, an analysis must be prepared based on international guidelines and best practices. The IRRS mission also drew attention to the lack of decommissioning requirements in the Radiation Act.

The Radiation Act establishes the obligation of the holder of a radiation practice licence to organise the monitoring of personal doses of exposed workers and the submission of monitoring data to the dose register, in where the amount of the effective dose caused by external radiation is also entered. If an exposed worker receives significant radiation due to the intake of radionuclides, the holder of the radiation practice licence arranges for the assessment or measurement of personal doses received by the exposed worker from the intake of radionuclides. There are no laboratories in Estonia that have a total body counter tube or perform a biological analysis to assess radioactivity in the human body. At the same time, there are few radiation practices in Estonia that use open radiation sources. These are limited to nuclear medicine and research and development. Therefore, it is necessary to analyse the need to assess the effective dose due to intake of radionuclides and possible assessment methods, such as direct and indirect assessment. During the analysis, the need to amend the Radiation Act or a regulation issued on the basis thereof must also be assessed. The IRRS mission also highlighted the fact that there is no possibility in the state to estimate the dose caused by the intake of radionuclides. In Estonia, there is currently no full body scanner for assessing internal radiation and it is not possible to perform bioanalyses. As the establishment of such opportunities is expensive and the number of service users is small, an analysis must be prepared in order to find and implement a suitable internal exposure assessment methodology and to study the possibilities of introducing a body scanner or bioanalyses in Estonia. At present, the prices of equipment, their maintenance costs, methodology, etc. and the pros and cons of these two internal exposure assessment methodologies or the possibilities of introducing alternative internal exposure assessment methodologies are unknown.

2.1.3. Radiation safety monitoring

According to the Radiation Act, the Environmental Inspectorate carries out state supervision of radiation safety. In 2018, the Labour Inspectorate was added to the monitoring of compliance with the requirements of the Radiation Act, which in cooperation with the Environmental Inspectorate monitors compliance with the requirements of Regulation "Reference levels for indoor radon concentration in workrooms, the procedure for radon measurements and obligations of employers at workplaces with an increased radon risk". The Health Board (hereinafter "TA") is also involved in the performance of state supervision of radiation safety.

State supervision is carried out on the basis of an annual work plan approved by the Director General of the Environmental Inspectorate. Planning is based on the IAEA guidance documents. The selection of sites is based on the fact that high-risk radiation practices are inspected every year, moderate-risk sites every two to three years and low-risk sites at least once every five years. The selection is also risk-based, i.e. attention is paid to expired and/or expiring radiation practice licences, as well as follow-up activities. In addition to scheduled inspections, unscheduled inspections are also carried out on those sites for which misdemeanour notifications have been received. A database with the official name "Object inspection database system", i.e. OKAS, is used for the orderly collection and analysis of data related to the supervision procedure. Inspectors are guaranteed access to the data of radiation practice licences in the KOTKAS information system and vice versa. During the 2016 IRRS mission, one of the problems was that there is no link between KOTKAS and OKAS, which would make it easier for the KeA staff to take the results of monitoring into account when processing radiation practice licences and ensure inspectors' quick access to radiation practice licence data. Links between registers are created during their development.

The selection of sites is based primarily on the degree of danger and the frequency of the need for control, not so much on the field of activity. According to the same principle, all radiation practice licences issued in the areas of industry, transport, services and medicine are inspected. Guidance materials and checklists have been developed for different areas, based on IAEA recommendations, national law and the conditions set out in the radiation practice licence. Radiation practice licences issued to medical institutions amount to approximately 75% of all issued radiation practice licences and, therefore, the vast majority of supervisory activities are performed in this area. After each inspection, the Environmental Inspectorate prepares a report, which may be either in free form or a special checklist. Sectoral guidelines for the inspection of radiation practice have been developed, for example, for the inspection of the transport of radioactive materials, industrial radiography, the use of stationary measuring equipment, X-ray diagnostics, dental X-ray, radiation licences for radiation equipment. Separate company-specific checklists have also been drawn up for the inspection of some high-risk radiation practice licence holders.

From November 2016, radiation practice licences for low-risk radiation practice will be issued for an indefinite period. By the end of 2021, all radiation practice licences previously valid for five years will have been replaced. At the same time, the role of KKI in ensuring radiation safety will increase significantly, as there is no need to apply for a new radiation practice licence at least once every five years.

In medical institutions, KKI monitors the aspects reflected in the radiation practice licence. TA checks the compliance of the radiation emitting device with the established requirements and verifies that its regular maintenance has been performed by competent persons. In order to harmonise inspection procedures, guidelines for inspection of radiation practice have been developed for preparation of work plans, selection of objects to be inspected, preparation of an inspection plan, preparation and performance of inspections, as well as procedures for inspection of basic radiation practice have been developed and implemented.

With the amendment to the Radiation Act that entered into force on 6 July 2018, the Labour Inspectorate (hereinafter "TI") was added to the list of monitoring agencies. It monitors the compliance with the requirements of Regulation No 28 of the Minister of the Environment of 30 July 2018 "Reference levels for indoor radon concentration in workrooms, the procedure for radon measurements and obligations of employers at workplaces with an increased radon risk" in cooperation with KKI. During the routine monitoring of employers, TI verifies, among other physical hazards, whether radon has been measured (asks for a report of measurement results) if the workplace is located underground, on the ground floor of the building or on the first floor of a building if the ground floor is missing in the territory of the local government recognised as a radon-hazardous area listed in the Annex to the Regulation. In situations where the reference level of radon has been exceeded even after the implementation of structural corrective measures, the employer is required to notify the Environmental Board. The radon content of the air in the workplace must be measured by 1 July 2023, at the latest. In the preceding period, the supervisory authorities will be responsible for radon information work, aimed in particular at employers. The focus will also be on the training of TI and KKI inspectors to increase their radon competence. Attention also needs to be paid to inter-agency cooperation in the field of radon.

On the basis of the Radiation Act, the Minister of Health and Labour established Regulation No 71 of 19 December 2018 "Radiation safety requirements for medical exposure procedures, requirements for clinical audit of medical exposure procedures and diagnostic reference values and requirements for their determination". During the amendment to the Radiation Act, which entered into force in 2018, diagnostic reference values were added to the Regulation. As according to the Radiation Act, the Health Board (TA) has not been appointed as the supervisor, currently KKI is also the supervisor of this Regulation.

The provisions governing the role of supervisory authorities in the field of medicine need to be clarified. The issue has also been highlighted in the IAEA IRRS mission report prepared in 2016. In order to better organise the exchange of information and monitoring, the functioning of monitoring and the coherence between laws need to be further analysed and clarified, if necessary. One possibility is also to conclude an inter-agency cooperation agreement, which defines the tasks of TA and KKI in the performance of monitoring and the exchange of information on the topic of radiation practice licences.

2.2. Raising radiation safety awareness and ensuring competence

2.2.1. Development of radiation training

Education related to radiation and nuclear safety provided in Estonia (including level education and training) can be divided into four groups: 1) general education training events / courses and level training in educational and in-service training institutions, 2) training events of exposed workers and radiation safety specialists,

3) training events of radiation experts, 4) training events of staff of regulatory agencies. At present, training events for exposed workers and radiation safety specialists take place relatively regularly in Estonia, while training is offered less frequently or not at all to the other aforementioned groups. Ensuring the continuity of radiation safety training in the field of natural and exact sciences has also been interrupted. Without the support of educational institutions, the level of radiation knowledge in Estonia is not sustainable.

Radiation safety training provided by educational institutions

Since the mid-1990s, radiation safety has been included in the curricula of several Estonian higher education institutions. At Tallinn University, radiation-related issues have been reflected primarily in the discussion of topics related to environmental monitoring. The University of Tartu and Tartu Health Care College provide subject courses in the area of radiation targeted at medicine, such as the basics of radiation biology and radiation therapy; medical exposure procedures; radiation biology, etc. The radiation lectures are mainly in the curriculum of radiography and radiology technicians of Tartu Health Care College.

In the field of medical sciences at the University of Tartu, radiology training in pre-graduate medical studies is organised according to curricula. Radiology studies take place in the third and fifth academic years and include, inter alia, radiation safety, the basics of the optimal use of radiation and the principles of justification for referral to examination. However, the volume of studying is too small, allowing only a brief acquaintance with radiology.

Attention should be paid to the adequacy of medical exposure training in pre-graduate medical and dental training. Existing studying could, as far as possible, address the safety requirements of medical exposure and the clinical use of medical exposure methods. Attention should also be paid to the system of in-service training for doctors and specialists in order to ensure a broad and up-to-date level of knowledge in the area of medical exposure.

As of the end of 2018, there were a total of 261 radiologists in the register of health care workers of the Health Board. According to the 2017 data of the National Institute for Health Development, there were 199 employed radiologists, 174.6 contracted positions and 156.8 actually filled positions. According to a study “A vision for labour and skills needs: Health” prepared as part of the labour demand monitoring and forecasting system OSKA, the share of radiologists in the total medical profession is about 4%. Radiology is also one of the specialties in which residents have expressed hesitation as to whether they will be able to find a pleasant job when completing their residency. The residency in radiology in Estonia lasts five years. The competence of radiologists is assessed by the Estonian Association of Radiologists.

Based on the 2017 data of the National Institute for Health Development, there are 411 employed radiology technicians (including radiology nurses) and 361.4 contracted positions. According to a study prepared as part of the aforementioned OSKA, the number of radiology technicians (including radiology nurses) has increased by 8% from 2013–2015 and will continue to grow in the future. There is also no forecast of a shortage of radiology technicians. The training of a radiology technician lasts 3.5 years in Estonia and as a result applied higher education is acquired. As an opportunity, one can continue their master’s studies in the radiography curriculum. It is also possible to continue studies abroad or in Estonia in the areas of medical physics, public health, economics, etc.

An expert in medical physics may be a natural person who holds an authorised certificate of biomedical technology engineer or an equivalent in the area of diagnostic radiology, nuclear medicine or radiation therapy. The professional certificate of an authorised biomedical technology engineer (Estonian and European Qualifications Framework level 8) is obtained after acquiring the relevant specialty and having at least four years of practical work experience. According to

the Estonian Qualifications Authority (Sihtasutus Kutsekoda), there are a total of 19 authorised biomedical technology engineers in Estonia.

In the field of medical sciences, there is also the possibility of using in-service training in the framework of IAEA technical cooperation projects, but this possibility is declining (as these projects are primarily targeted at developing countries).

Attention should be paid to the development of a balanced training and further training system to ensure the availability of medical exposure training, including radiation safety, to doctors, radiologists and medical physicists in all disciplines.

In the field of natural and exact sciences, the topics related to radiation protection were most thoroughly discussed in the respective lecture courses of environmental physics at the University of Tartu. Unfortunately, lectures on radiation safety are no longer organised. The teaching of the principles of radiation protection is not currently a compulsory part of any curriculum in the field of natural and exact sciences, but the return of this course and its inclusion in the curricula should be assessed. If it is not possible to create a lecture course on the basics of radiation protection, then an online learning programme could be implemented at some Estonian higher education institutions, the administration of which would be significantly less time-consuming after completion. The basis could be, for example, the online course “Radiation Protection” completed as part of the BeSt programme, the target group of which was mostly students of Türi College of the University of Tartu and the Open University. The materials of this online course are still publicly available among UT electronic study materials, reference: https://dspace.ut.ee/handle/10062/14234.

For many years, the Research School of the University of Tartu has provided high school students with the opportunity to gain additional knowledge in various fields. One of such opportunities is the radiation safety course “From cosmic radiation to a nuclear power plant”. It is an online course and about 20 young people participate in the course each year. The course primarily provides an overview of the various radiation sources around us.

With the transposition of the Basic Safety Standards Directive 2013/59/Euratom into Estonian law, requirements for taking into account the radon risk were also set at the level of legislation. In this context, there is a growing need to complement design and construction curricula in the field of natural radiation, in particular in terms of radon. The aim is to increase the awareness of construction professionals about radon and radon protection measures, which should be taken into account both in the design of buildings and in renovation work. The promotion of radiation training is also necessary to improve and introduce a general safety culture. This applies to both radiation practice licence holders and staff of regulatory agencies.

Training of exposed workers and radiation safety specialists

The training offered by the training companies is mainly aimed at exposed workers or radiation safety specialists. In most cases, training companies do not have the competence for such training and, therefore, the help of people involved in the field is used, and the training company is mainly engaged in the organisational side of the training.

While for years the training events were mainly aimed at exposed workers, recently training events for radiation safety specialists have also emerged as a separate category. This development is mainly due to legislative modifications. With the 2016 amendment to the Radiation Act, the definition of a radiation safety specialist was added to the Act and Regulation No 57 of the Minister of the Environment of 24 November 2016 "Requirements for radiation safety training of radiation safety specialists and exposed workers" was updated with radiation safety specialist training requirements. The training requirements for exposed workers were also significantly improved. The Regulation establishes that exposed workers must have passed both initial and in-service training. Training companies follow the requirements of the content of the initial training of an exposed worker and a radiation safety specialist set out in the regulation when planning training events. Training events for exposed workers in Estonia provide an overview of the theoretical foundations of radiation safety and the practical implementation of the principles of radiation protection. In addition to more thorough theoretical preparation, the training of a radiation safety specialist includes practical exercises. Initial and in-service training is provided to exposed workers by a specialist with at least three years' experience in the area of radiation safety or by a radiation expert with a valid certificate. Training for radiation safety specialists is provided by a radiation expert with a valid certificate.

Some training companies are also trying to provide more targeted training – such as radiation safety training for dental facilities, but most training events focus on general radiation safety principles. This situation is also due to the fact that while dental institutions account for a relatively large share of holders of issued radiation practice licences, the remaining areas of activity are more modestly represented and the use of a targeted approach is difficult. Both in terms of time and logistics, it is more difficult to reach a situation where there are enough exposed workers for similar activities to perform the training that is economically justified. At the same time, the situation is even more complicated for radiation safety specialists. Although some training events advertise themselves as practical training events, these are mostly classroom training events.

Training of radiation experts

There are no opportunities for training radiation experts in Estonia. The introduction of the curriculum for the training of radiation experts established in Regulation No 45 of the Minister of the Environment of 27 October 2016 "Radiation safety training curriculum, professional competence requirements, certificate application procedure, application form and certificate form" is difficult in Estonia. A survey was conducted in the EU Member States on the training of radiation experts, and several countries stated that setting up such a training system at national level was too expensive and, in practice, relatively impossible. In the event of Estonia, it must be taken into account that the number of radiation experts in the country will most likely remain around ten. At present, there are seven qualified radiation experts in Estonia who have been working in the field for many years, and since the licence of a radiation expert is valid for five years, this is either the second or third term for many radiation experts. It also means that these people have found training opportunities. New radiation experts are expected to be added in a few years. It is extremely difficult to build a training system without a definite training need. All the more so as, currently, there is no possibility of radiation safety training in Estonia even at the basic level. However, given the limited number of radiation experts, the financial side of providing such training opportunities is problematic, but it is also difficult to find suitable training providers. In the event of radiation experts, in addition to training, it is important to have experience, and becoming an expert also requires previous work in this area. However, there is no great need for radiation experts arising from the legislation. The Radiation

Act establishes the cases in which it is necessary to consult a radiation expert, but there is a strict obligation to involve a radiation expert only in the design of radiation facilities and the introduction of new radiation sources. The above-mentioned Regulation significantly specified the requirements for radiation experts and certificates were started to be issued on the basis of the field. The lack of specification in the area caused problems in the past when an applicant for or a holder of radiation practice licence wanted to order a consulting service from a radiation expert. The certificate presumed as if one should have knowledge in all areas, but the medical specialist is not competent to provide advice in the field of radioactive waste management and vice versa. Although the so-called main field of the expert was known domestically, this was not reflected in the certificate. The new system has made it clearer to issue certificates to experts and also allows service subscribers to find their way around.

In all likelihood, it can be said that most Estonian radiation experts work as radiation specialists under an additional obligation, and we do not have people working as full-time radiation experts.

In summary, the organisation of initial training for radiation experts at national level is currently difficult and the costs involved do not comply with the potential benefits. Furthermore, it must be taken into account that new radiation experts are added relatively infrequently and that existing radiation experts have already completed their initial training. As different training opportunities can be found at the international level, radiation experts have the option to ensure their own (additional) training.

Training of regulatory staff

The regulatory agencies in the field of radiation include the Environmental Board, the Environmental Inspectorate, the Ministry of the Environment, the Health Board, the Rescue Board, the Security Police, the Police and Border Guard Board, the Tax and Customs Board, the Labour Inspectorate, and A.L.A.R.A. AS. Due to the different responsibilities of the regulatory agencies, the levels of knowledge required by the staff of these agencies may be set differently. The training of inspectors of the Environmental Inspectorate has been regular and it has taken place every year in cooperation with the Radiation Department of the Environmental Board. The training programme has been developed by the Radiation Department of the Environmental Board and it will be modified according to the needs of KKI. Specialists of the KeA radiation department advise the KKI inspectors on issues related to the specifics of the area of radiation practice as necessary. Cooperation and exchange of information on monitoring issues will take place continuously. In addition, KKI inspectors participate in seminars and courses organised by the IAEA. KKI’s general radiation knowledge has significantly improved thanks to regular training, but inspectors also need additional training in specific areas of radiation practice, such as the safety requirements of radiation sources used in the industry. In addition to training, KeA and KKI meetings should also be organised in the form of a seminar in order to improve the exchange of information and share experiences.

It is also necessary to organise training in the field of radiation for other monitoring agencies, for example, training in measuring radon concentrations for the employees of the Labour Inspectorate. Such a training was organised by the Ministry of the Environment in 2016 for companies and supervisory authorities engaged in radon measurement.

There is also a need for training in the field of preparedness for radiation events. Awareness is insufficient and needs to be improved for first responders and regulators who may be in direct contact with radiation sources during their duties (Rescue Unit of the Rescue Board (hereinafter “PäA”), Police and Border Guard Board (hereinafter “PPA”), ambulance and Tax and Customs Board (hereinafter “EMTA”)), therefore, they do not know how to assess the risk or use the available tools. As of 2018, the Security Police (hereinafter “KAPO”) and the Special Chemistry Service of PäA have awareness and competence, but in-service training is needed to maintain competence. A.L.A.R.A. AS also needs regular training on how to eliminate the emergency exposure situation.

KeA organises a weekly radiation safety training once a year, which is also open to people outside the agency. So far, in addition to the KeA employees, officials of the Ministry of the Environment and KKI inspectors, as well as employees of the Tax and Customs Board and the Health Board have participated in it.

In addition to the annual radiation safety training organised by KeA, it is necessary to compile and launch an online course “Introduction to radiation protection” and to update it regularly. The online learning programme module could be based on the IAEA CONNECT platform, for example. Given that it is relatively difficult to obtain knowledge related to radiation safety in Estonia during the acquisition of education, this means that in a normal situation a person holding a position related to radiation is often without special sectoral knowledge. Although it is possible to make use of international training opportunities, it would be necessary to provide an introduction to the topic in the mother tongue. Another advantage of the online course is that it can be taken as soon as one starts a new job.

Topics covered in basic training should include at least the following:

- biological effects caused by ionising radiation;
- natural and artificial radiation sources;
- radiation monitoring;
- use of radiation sources: science, industry and medicine;
- basic principles of radiation safety;
- radiation events;
- radiation safety law, etc.

These are topics that should be known to all officials involved in the field of radiation. As the number of people who need this course is small and it also varies from year to year, it is especially suitable to use an online course. It would be expedient for a specific person to be responsible for the course, who would check the timeliness of the information provided at least once a year and would also assist the course participants, if necessary.

In Estonia, training of employees of regulatory agencies on specific radiation topics is not organised (the creation of such an opportunity is not reasonable due to the specificity of the field). Training provided in the framework of IAEA technical cooperation is being used to alleviate the problem. However, the number of participants in the training is limited, which means that not all employees with training needs can participate in the training. At the same time, there are also few resources to send a staff member to training, after which they would train others when they return, as the relevant training is expensive and the opportunities offered by the IAEA do not always match the needs of the state. One of the mitigation options is to use the possibility of “hosting” international training events (offering a training venue), thanks to which we could involve more Estonian participants in the training.

2.2.2. Ensuring a sufficient number of radiation specialists

While radiation licence holders have the necessary exposed workers and radiation safety specialists, it is often difficult for regulators to find competent staff, and the departure of one staff member also has a major impact. As of the end of 2018, there were seven radiation experts in Estonia. Approximately 60 radiation safety specialists have been appointed to the holders of radiation practice licences. There were 16 people working in the Radiation Department of the Environmental Board and two people working in the radiation field in the Ministry of the Environment. In addition to the principal work, 15 inspectors perform radiation safety supervision at the Environmental Inspectorate. Ten specialists were employed at the radioactive waste operator A.L.A.R.A. AS. In general, the number of radiation specialists of the regulatory authorities so far has been sufficient to cover national needs. Due to the regulation of a new field of radiation – radon – at the level of legislation, in 2019, it is necessary to create at least one additional radon specialist position in KeA in order to cope with the increased demand for radon consulting and indoor radon measurement. In order to improve the quality of inspections of the radiation practice licence holders and increase the radiation competence of the KKI inspectors, an opportunity should be created from 2019–2021 to appoint inspectors specialising in the area of radiation. In order to meet the needs of the radiation sector, it would be sufficient to appoint two inspectors in this field. Due to the increase in the volume of additional reporting arising from EU directives and international conventions, the need to create an additional position from 2019–2021 is also felt by KeM. The increase in the workload of A.L.A.R.A. AS, which is responsible for radioactive waste management, has been related to the construction of a final radioactive waste storage site and decommissioning of the reactor sections of the former nuclear site in Paldiski since 2020, requiring at least one position. In order to ensure a sufficient number of radiation specialists, it is necessary to develop the field of training and ensure the availability of radiation knowledge. To contribute to the wider dissemination of knowledge, attention should be paid not only to the training of professionals but also to the training of training providers. As their training is time-consuming and resource-intensive and there are no opportunities to do so nationally, cooperation options with the IAEA should be sought. The development of leaders and people in leading positions in the area of radiation, which plays a major role in promoting the efficient functioning of institutions and inter-agency cooperation, has also been neglected. Therefore, in addition to increasing their knowledge of radiation, their management skills should be developed by including in-service training in their training programmes.

2.2.3. Radiation research and development

In accordance with clause 13 (1) 1) of the Organisation of Research and Development Act, the functions of all ministries include the organisation of the required research and development in their areas of government and the financing thereof, taking into account the results of evaluation and the related assessments and recommendations. According to clause 2 of the same section, the ministries are responsible for the development and organisation of research and development programmes both in the state and in their area of government.

The amount and complexity of upcoming problems and challenges in the field of environment has increased in Estonia, as well as the rest of the world, therefore, investment into R&D has proven to be a successful practice, facilitating the impact of research in ensuring national interests and adoption of decisions. The aim of the R&D activities of the Ministry of the Environment is to ensure a clean environment and the sustainable use of natural resources by developing better solutions, technologies and processes through the R&D activities and by disseminating and promoting their use. According to the 2018 amendment to the Radiation Act, KeA and KKI must take into account the development of relevant technology and research in their activities.

In order to achieve the objectives and increase the impact of research and development, the most important activities of the Ministry of the Environment are the following:

1. Sectoral applied research needed to provide science-based input to policy-making and legislation.
2. Coordination and funding of participation in international research collaboration projects, including joint programming initiatives (JPI), ERA-Net projects and other international research collaboration projects.
3. Ensuring the sustainability of sectoral research and development and human resource development.

The R&D radiation activities in Estonia are largely project-based and mostly funded from the research institutions and outside the budget of universities, from EU and Environmental Investment Centre (hereinafter "KIK") funds, as well as from the budget of the Ministry of the Environment.

In the field of radiation research, UT and TalTech have a leading position in research on radioactivity in drinking water, NORMs, radon, construction materials and the environment. Radon research has also been commissioned from the Geological Service (formerly Geoloogiakeskus OÜ). The research and development activities of the holders of radiation practice licences have been modest, but scientific research and studies on the application of new technology have been commissioned by water companies and one industrial company in connection with NORM waste.

In the field of radiation, research is needed to support the protection of humans and the natural environment from the harmful effects of ionising radiation. The main radiation topics in research and development that should be focused on in the future are the following:

- the development of waste characterisation procedures for the determination of alpha and beta emitters;
- the development of the procedures necessary for the clearance of waste;
- the support of research and development in the field of free technology for NORM residues and/or waste;
- soil radon studies;
- additional radiological examinations of construction materials used in Estonia.

2.2.4. General radiation awareness

In order to inform the public in order to increase general radiation awareness, information days are organised, information is updated on the websites of agencies, information materials are developed, training events are organised, and information is disseminated through media (television, radio, press).

Information days

Compared to KORAK of the previous period, the general radiation awareness of the population has increased. This is largely thanks to the increase in information found on the Internet and media coverage of radiation topics. The annual information days for the public organised by the Ministry of the Environment have also helped. Presentations of the information day are available on the website of the Ministry of the Environment.

Websites

Radiation information, including information materials (including research, studies), information materials and other helpful instructions, is available, for example, on the following websites:

- https://www.envir.ee/ – website of the Ministry of the Environment;
- https://www.keskkonnaamet.ee/ – website of the Environmental Board;
- http://alara.ee/ – A.L.A.R.A. AS (orphan sources, radioactive waste);
- https://www.egt.ee/ – Estonian Geological Service (radon);
- http://www.terviseamet.ee/ – Health Board (radionuclides in drinking water);
- https://www.evs.ee/ – Estonian Centre for Standardisation (radon measurement and radon safe building design standards).

Training events

In addition to information days for the public and information available on websites, training is provided as needed, and the same applies to training for target groups. The training events are addressed in Chapter 2.2.1.

Media

In addition to the above, the Ministry of the Environment and other agencies provide information in the media (television, radio, press).

In the future, greater emphasis must be placed on raising the radiation awareness of various target groups. For example, attention should be paid to raising the awareness of employers, labour inspectors and environmental inspectors, as well as builders and planners (local government officials) about radon exposure and the nuances associated with it.

26. On 26 July 2018, the Government of the Republic adopted Regulation No 63 "Emergencies for which a resolution plan must be prepared and risk communication must be organised, and emergency management agencies", which established that the Environmental Board manages the resolution of the following emergencies and the preparation of an emergency response plan: 1) a radiation accident in a neighbouring country and 2) a domestic radiation accident. In the event of the listed emergencies, risk communication must be organised, i.e. informing the public about the dangers that may cause the emergency and the consequences of the emergency and providing instructions to the population in order to increase awareness and preparedness for emergencies. The Environmental Board is responsible for organising risk communication and relevant information is made available on its website.

The Ministry of the Environment, in cooperation with the Environmental Board and A.L.A.R.A. AS and under the financing of the Environmental Investment Centre, organised campaigns for the collection of equipment containing nuclear material and other potentially hazardous radioactive waste in 2009, 2010, 2012 and 2015. To facilitate the collection, the campaigns produced information and guidance materials that provided an overview of the risks associated with radiation sources, explained the reasons for orphan sources and informed the public on how and to whom to inform about any radiation sources found. The volume of such waste is likely to decrease in the future, as the waste collected during the campaigns is of historical origin and it is likely that most of it has been collected over the years. Nevertheless, regular campaigns for the collection and information of equipment containing nuclear material and other potentially hazardous radioactive waste must continue.

2.3. Radioactive waste management

Substances, materials or items that contain radionuclides or have been contaminated with them, have greater activity or specific activity than the clearance levels established on the basis of the Radiation Act, and are not planned to be used in the future, are considered radioactive waste. There are no nuclear power plants in Estonia, as well as no activities related to the nuclear fuel cycle and no operating facilities. As the former nuclear site in Paldiski is a training (learning) centre, which does not directly fall within the scope of Directives 2009/71/Euratom and 2014/87/Euratom, the requirements of these directives must be applied in Estonia at a general level. As ensuring radiation safety is extremely important for Estonia, the requirements of the Directives will be taken into account as much as possible when decommissioning the Paldiski site, while ensuring a reasonable administrative burden.

Most of Estonia's radioactive waste dates back to the Soviet era – the former nuclear site in Paldiski, Tammiku radioactive waste storage facility and Sillamäe NORM waste storage site. Sillamäe radioactive tailing pond of NORM waste and its monitoring are described in the radiation monitoring chapter (2.5.1). Today, the main generators of radioactive waste are licenced medical, industrial and scientific institutions.

In the case of radioactive waste, a distinction is made between artificial and NORM waste/residues. The Radiation Act establishes that NORM waste is radioactive waste containing mainly natural radioactive material, including NORM waste that is not intended for future use, and NORM residues are substances containing or contaminated with a naturally occurring radioactive substance resulting from an activity, the activity or activity concentration of which exceeds the established clearance levels and which are intended to be used in the future. The generation of NORM waste can be avoided by finding ways to clear NORM residues. The management of NORM residues and waste requires a case-by-case approach, as depending on the source of origin, they have different chemical and physical characteristics and they cannot be / should not be treated in the same way as other radioactive waste. However, this requires the establishment of a waste management system that is optimal for society and meets radiation safety requirements. The establishment of a waste management system involves a coherent strategy for the management of NORM waste and residues.

<u>National Action Plan for Radioactive Waste Management</u>

The preparation of the National Action Plan for Radioactive Waste Management started immediately after the preparation of the National Development Plan for Radiation Safety 2008–2017 and the approval of its implementation plan. In 2011, Directive 2011/70/Euratom on the responsible and safe management of radioactive waste and spent fuel entered into force, which set out even more specific requirements for the preparation of a national action plan for radioactive waste management. In 2013, the European Commission also provided guidance to Member States on how to draw up the action plan referred to in the Directive to ensure a uniform structure of the plan and the extent of topics covered.

The action plan was approved by the Minister of the Environment with Order No 688 of 21 July 2015 and it was submitted to the European Commission in August 2015. On the basis of the action plan, issues related to radioactive waste management are organised in Estonia, and the aim of the plan is to offer decision-makers and waste handlers specific solutions for the systematic management of radioactive waste and the reduction of its quantities in Estonia. The plan also provides the general public with sufficient information on radioactive waste generated and to be generated in Estonia and its management.

The action plan provides an overview of existing and future radioactive waste in Estonia, its management methods, sets out a schedule of activities and national policy. The plan also describes the bodies authorised for the safe management of radioactive waste, the technical and financial resources available, the funding scheme and the R&D activities. The national action plan for radioactive waste management is carried out through the action plan.

The action plan presents the sub-objectives of the described fields, measures and expected results until 2050. It also describes the responsible institutions and the costs of carrying out the activities indicated in the action plan.

Due to the new Radiation Act, which entered into force on 1 November 2016, and in connection with the new developments in the field of NORM waste management, the action plan needed to be updated. The modernisation was also prompted by the preliminary studies of the decommissioning of the reactor sections of the former nuclear site in Paldiski and the final radioactive waste storage site, which were completed in 2015, and found that the only way to safely store radioactive waste is to establish a final storage site in Estonia. Based on these studies, the Government of the Republic adopted a decision at a cabinet meeting on 28 April 2016 to establish a final storage site in Estonia. Therefore, the National Action Plan for Radioactive Waste Management also specifies the demolition of the reactor sections of the former nuclear site in Paldiski and the establishment of a final radioactive waste storage site. The action plan was also updated on the basis of EU directives and national legislation. The updated action plan is provided as Annex 1 to KORAK. KORAK summarises the indicators, targets, measures and activities for the reduction of radioactive waste and the risks associated with its management.

The following is a brief overview of the generation, management, intermediate and final storage of radioactive waste.

<u>Former nuclear site in Paldiski, existing intermediate radioactive waste storage site and final radioactive waste storage site to be established in the future</u>

The Paldiski Nuclear Submarine Training Centre, established in the 1960s, used two submarine modelling stands with operating nuclear reactors. The Paldiski site was handed over to Estonia by the Russian Federation on 26 September 1995. Prior to leaving the Paldiski site, the working group of the Russian Federation removed nuclear fuel from the reactors and dismantled the training stands in accordance with the concluded agreement, leaving only both submarine sections containing a nuclear reactor in the main building, around which reinforced concrete sarcophagi were built. Estonia was responsible for the safe inclusion of all other facilities located at the site (e.g. radioactive liquid waste treatment complex, solid and liquid radioactive waste storage facilities, radioactively contaminated special sewerage and ventilation lines, chemical warehouses, etc.). The state began decontamination and demolition of the site immediately after its acceptance. In order to store the radioactive waste generated during the cleaning work, an intermediate storage site complying with international requirements was built in the main building of the Paldiski site in 1997, where all radioactive waste generated in Estonia today or in the future is stored nowadays. The main part of the stored radioactive waste is formed of the waste generated during the decommissioning of the Paldiski and Tammiku sites. The rest is waste received from other institutions and companies.

The long-term safe storage of the reactor sections at the Paldiski nuclear site will take place until 2040, after which, according to preliminary studies, the sections must be dismantled, the generated radioactive waste must be handled and stored at the final storage site. It is estimated that depending on the method of dismantling the sections, from 519 to 1545 m^3 of treated waste is generated. As it is not possible to store waste of such volume and activity in the intermediate storage site located in Paldiski, a final waste storage site must be established for this purpose by 2040, at the latest. The intermediate storage of radioactive waste, including long-term intermediate storage, is a temporary solution, not an alternative to final storage. Until the final storage site is established, the reactor sections and radioactive waste in Paldiski are in a condition where radioactive contamination of surface and groundwater and soil may occur as a result of an emergency caused by climate change or similar factors.

Tammiku radioactive waste storage facility

The RADON-type radioactive waste storage facility is located in Tammiku, which was established in the early 1960s as a storage site for radioactive waste generated in industrial enterprises, scientific and medical institutions and elsewhere in the territory of the then Estonian SSR. The storage site was in use from 1963–1995 and has been closed since 1996 as a site that does not meet modern radiation and environmental safety requirements. The storage site included an underground liquid waste container and a near-surface storage facility for solid waste. The waste in the liquid waste container was removed and the container was decommissioned in 2001. The waste was removed from the solid waste storage facility from 2008–2011 and transported to the waste management centre at the Paldiski site for further treatment, after which the waste was stored at the Paldiski intermediate storage site. In 2012, the decommissioning works of the repository (decontamination and demolition of the repository structures) started, which are expected to last until 2022, after which the repository area will be vacated for general use.

2.4. Radiation emergency preparedness

Estonia has joined to both the Convention on Nuclear Safety and the Convention on Early Notification of a Nuclear Accident and assesses the risks of nuclear accidents with cross-border proliferation and has a warning and response capability in accordance with International Atomic Energy Agency (IAEA) safety standards. For the IAEA and the European Commission (including the EC), Estonia's competent agency in these matters is the Environmental Board, which regularly participates in international exercises organised in the platforms established for the transmission and exchange of rapid alert information (IAEA USIE and EC ECURIE). The Environment Agency is the National Warning Point for nuclear and radiation matters at the IAEA and the European Commission and the competent agency for both domestic and international nuclear events.

The task of the radiation department of the Environmental Board is to organise monitoring of radioactivity in the environment and analysis of results, to perform laboratory analysis of radioactivity of substances and natural radiation research, to assess exposure of the population and to ensure the operation of the early warning system. Through an early warning system, the level of gamma radiation in the environment and the weekly content of radionuclides in airborne particles and aerosols are monitored in real time. In addition to the 15 automatic monitoring stations and three filter stations installed and scattered throughout the territory of Estonia, there is also a mobile radiation monitoring laboratory and several radiation measuring devices, as well as computer software – ARGOS – for forecasting the possible spread of pollution. Although the systems and tools managed by the Environmental Board and the resources required for radiation monitoring are sufficient to assess and identify radiation threats and warn of possible emergencies as of 2018, preparedness for possible domestic radiation events and international nuclear events needs further development and wider cooperation.

In order to assess the likelihood and possible consequences of a radiological emergency and to plan for their prevention and preparedness, it is necessary to ensure the adequacy of risk assessments in the event of a radiological emergency. In order to ensure emergency preparedness for radiation emergencies, emergency plans must be constantly updated, joint exercises must be organised, staff must be trained and the public must be made more aware of and prepared for radiation events.

The success of resolving radiation events depends to a large extent on the preparation of the population, including the awareness, preparedness and ability of people to act in an emergency. In order to make people aware and prepared to act correctly in emergencies, the public is informed about the dangers that can cause a crisis, and the population is provided with the possible consequences and instructions. From 2018, the Government of the Republic assigned the organisation of risk communication in the event of a radiation emergency to the Environmental Board, both in the event of a radiation accident in a neighbouring country and in the event of a domestic radiation accident. A survey commissioned by the Rescue Board in 2017 revealed that the awareness of the population about possible emergencies and the preparedness to cope with them independently is low, and that a serious emergency is rarely or not considered at all. This means that, at present, the population is not sufficiently prepared for radiological emergencies, which makes it more difficult for the agencies to resolve emergencies.

The training of agencies and institutions and the problems related to them are discussed in Chapter 2.2.

In accordance with the Emergency Act, the Director General of the Environmental Board approved the risk analysis of a radiation and nuclear accident in April 2018. The risk assessment focused on the types of radiological events that could cause an emergency and developed a risk matrix to assess the likelihood and severity of these events. In addition, an analysis of the capacity to prevent, prepare for and respond to radiation emergencies was carried out and conclusions were provided on critical capacity gaps and measures and tools. Based on the results of the risk analysis, the Government of the Republic determined (Regulation No 63 of 26 July 2018 "Emergencies for which a resolution plan must be prepared and risk communication must be organised, and emergency management agencies") the radiation accidents for which an emergency response plan is prepared: 1) a radiation accident in a neighbouring country and 2) a domestic radiation accident. The Government appointed the Environmental Board to prepare the above-mentioned emergency response plans and to manage the emergency response, which, with the parties involved in the emergency response, will prepare the plans by 1 July 2019 and keep them updated thereafter.

In connection with the new task of the Environmental Board to manage the resolution of radiological emergencies, additional resources must also be invested in ensuring management capacity and preparedness. The capacity and preparedness of all emergency response agencies must ensure the agreed response, operational capability and continuity. The resources of emergency response agencies need to be constantly updated and modified. The security measures in place also need to be continuously developed to ensure the safety of responders to radiological events and the adequacy of the measures implemented to the dangers, including the necessary storage of protective equipment and radiation measuring equipment to solve radiological emergencies.

The capacity to decontaminate people, equipment and the site should be developed to meet the relevant needs.

Radiation emergency preparedness includes, inter alia, the ability to address the consequences.

To achieve this, the basics are needed to be better prepared to address the consequences of a radiological emergency, including the ability to quickly and effectively assess the damage caused by a radiological emergency and to take the necessary measures to compensate for the damage.

The continuity of radiation response facilities means their ability to perform their tasks for at least 168 consecutive hours. There are difficulties for all involved in ensuring this. In addition, the preparedness of emergency services must be ensured around the clock (24/7). For example, at the moment, A.L.A.R.A. AS has a 13/7 response preparedness, which is not sufficient for the operative elimination of the emergency exposure situation.

In addition to increasing the response capacity of A.L.A.R.A. AS, the base of the company's measuring instruments and decontamination equipment needs to be upgraded in order to eliminate the emergency exposure situation.

General emergency cooperation agreements have been concluded with Sweden, Finland and Latvia.

2.5. Natural radiation

2.5.1. Radiation monitoring

One part of the national environmental monitoring programme is the radiation monitoring sub-programme, the responsible person of which is the Environmental Board. The obligation to carry out radiation monitoring derives from the Treaty establishing the European Atomic Energy Community (EURATOM) and its methodology is described in Commission Recommendation 2000/473/Euratom. The requirements for radiation monitoring are described in the Radiation Act and the Environmental Monitoring Act and their sub-acts.

During radiation monitoring, changes in the level of radioactivity in the environment are monitored over time and the compliance of the activity concentrations of radionuclides in the environment with the established limits and the radiation doses received by the population are assessed. The main task of radiation monitoring is to detect and monitor the increase in radioactivity caused by human activities, i.e. the spread of artificial radionuclides. An important output is the provision of warning information on radioactive contamination of the environment in the event of possible nuclear accidents in neighbouring countries and other accidents resulting in the release of radioactive contamination into the environment. The presence of natural radionuclides in the environment is mainly studied in research.

During radiation monitoring, air samples, surface water, drinking water, milk, food and soil are collected and analysed annually, and the dose rate of gamma radiation in the air is constantly monitored. As Estonia has joined the Convention on the Protection of the Marine Environment of the Baltic Sea Area, marine samples (seawater, biota and sediments) will also be collected and analysed. The monitoring results are published on the website of the Environmental Board. Gradually, the storage and making available of all state environmental monitoring data, including radiation monitoring reports, in the state environmental monitoring database KESE (kese.envir.ee) will be ensured.

For radiation monitoring, there are 15 automatic air radiation monitoring stations, three air filter devices, the laboratory of the Environmental Board for the analysis of samples, a mobile measurement laboratory and inter-agency cooperation for the collection of samples. There is participation in international radiation monitoring cooperation and data exchange. The European Commission conducts regular audits to verify the effectiveness of radiation monitoring and compliance with international and national requirements.

During the Estonian-Swiss cooperation programme project "Renewal of Estonian radiation monitoring", the capacity of Estonian radiation monitoring was significantly increased from 2012–2016 by updating and renewing the most important measuring equipment and instruments used for radiation monitoring. In order to ensure the smooth operation of radiation monitoring and high-quality and reliable measurement results, it is necessary to continue to regularly update monitoring and laboratory equipment and to ensure the availability of competent staff. The radiation monitoring sub-programme needs to be regularly reviewed and strengthened as necessary. It is important to ensure radiation monitoring even in the event of a radiation emergency. A strategy for radiation monitoring in the event of a radiological emergency must be prepared. In the event of a radiological emergency, it is necessary to additionally measure the radiation level and perform lab analyses. The availability of radiation monitoring information to the public must continue to be ensured.

Environmental radiation monitoring is also performed by holders of radiation practice licences in accordance with the conditions of the radiation practice licence. In addition, the Ministry of the Environment, in cooperation with Ökosil Keskkonnalabor AS, organises radiation monitoring on the territory of Sillamäe waste storage site.

<u>Monitoring of Sillamäe radioactive tailing pond</u>

Sillamäe radioactive tailing pond covers an area of nearly 50 ha and contains about 12 million tonnes of uranium production residues and oil shale ash, which has been stored there since the commissioning of the Soviet uranium plant in 1948.

The reorganisation project of Sillamäe waste storage site was initiated by the Estonian state and Silmet Grupp AS in 1997. The main goal of the project was the environmental reorganisation of the waste storage site in order to reduce its potential emissions to water and air. The reorganisation project was completed in December 2008. At present, the covered waste storage site looks like a mound covered with vegetation, to which a significant amount of water cannot enter. The radiation background of the waste storage site is at the level of the natural radiation background, the stability of the dam is ensured by a belt of reinforced concrete piles built on the shore, and shore protection has been built against the wearing activities of the sea.

A two-part monitoring programme of Sillamäe waste storage site has been prepared to assess the efficiency of the implemented reorganisation works and to monitor the environmental condition of the waste storage site and its impact area. The first stage of the monitoring programme was part of a reorganisation project completed from 2002–2008. In 2009, the second stage of the monitoring programme, i.e. follow-up monitoring, was started. The purpose of follow-up monitoring is to monitor the environmental condition of the waste storage site and its impact area and its possible significant changes, as well as to assess the efficiency of the reorganisation works. During the follow-up, the radiation safety of the site is also inspected in order to increase the public's confidence in the safety of the site.

According to the results of the follow-up, the environmental parameters and indicators of the waste storage site are in the expected range. The environmental protection reorganisation works of the waste storage site have been carried out efficiently, the follow-up of the project functions in accordance with the set objectives, and the final cover of the waste storage site operates as set in the project. In the long term, the monitoring of the site and the documentation and availability of information to future generations will be ensured.

In 2014, a programme approved by the Ministry of the Environment was launched, and on the basis of proposals from Wismut GmbH, the designer and supervisor of the closure project of the waste storage site, with a reduced monitoring frequency for the second monitoring period of the waste disposal site. Visual, gamma radiation, radon exhalation, geotechnical, subsidence, well water levels, final coating operation and leachate chemical composition are monitored.

2.5.2. Drinking water

The higher content of natural radionuclides in Estonian groundwater has been known for over twenty years. The first systematic studies of the content of radionuclides in Estonian groundwater were started in 1994.[7] Several large-scale projects have been implemented over the last decade to identify the nationwide scale of the problem.[8,9] A study completed in 2009[8] estimated that approximately 18% of the Estonian population (230,000 people) consumes drinking water, the dose of which exceeds the reference value established by legislation.

Regulation No 61 of the Minister of Social Affairs of 24 September 2019 “Drinking water quality and control requirements and methods of analysis” establishes requirements for the quality and control of drinking water and methods of analysis of drinking water samples in order to protect human health from the harmful effects of drinking water contamination. The Regulation establishes radiological quality indicators for tritium, radon and indicative dose. The indicative dose is the expected effective dose from annual intake from all artificial and natural radionuclides detected in drinking water, with the exception of tritium, potassium-40, radon and radon short-lived decay products. The reference value for the indicative dose for drinking water is 0.1 mSv. The reference value of the parameter is the value of a radiological indicator above which the radioactive substances in drinking water pose a risk to human health that requires action and, where necessary, remedial action will be taken to bring the quality of the water up to the level required for the protection of human health from the point of view of radiation protection.

Exceeding the indicative dose of the reference value occurs in areas where groundwater from the Cambrian-Vendian aqueous layer is used as a source of drinking water. It is an aqueous layer that is well protected by the external environment, in which the high concentration of radionuclides results from the uranium and thorium-rich crystalline bedrock on which the aqueous layer is located, and from the rocks surrounding the water layer.[10] This aqueous layer is mostly used in northern Estonia – Harju County, Lääne-Viru County and Ida-Viru County – where it is most accessible. Exceeding the indicative dose in Cambrian-Vendian groundwater is caused by high levels of radium isotopes – ^{226}Ra and ^{228}Ra. Bone, bladder, breast, blood and lung cancers in particular are considered to be a health risk associated with the consumption of drinking water with a high radium content. Studies to date show that the presence of other uranium and thorium radionuclides in Cambrian-Vendian groundwater is not a problem, as the environmental conditions of the aqueous layer are not suitable for the dissolution of these elements.[11]

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[7] Savitskaja, L., Viigand, A. 1994. Report on the study of micro-components and isotopic composition of groundwater in the Cambrian-Vendian water complex for the assessment of drinking water quality in northern Estonia. Tallinn, Geological Survey of Estonia.

[8] Forte, M., Bagnato, L., Caldognetto, E., Risica, S., Trotti, F., Rusconi, R., 2010. Radium isotopes in Estonian groundwater: measurements, analytical correlations, population dose and a proposal for a monitoring strategy. Journal of Radiation Protection. 30, 761–780.

[9] Health Board, 2014. Environmental programme project No 49 of KIK “Determination of radionuclide content in water from aqueduct of southern Estonia http://www.terviseamet.ee/fileadmin/dok/Keskkonnatervis/vesi/TF_radionukliid/KIK_radionukliidiseire-Tulemuste_kokkuvote.pdf.

[10] Wisser, S., 2003. Balancing Natural Radionuclides in Drinking Water Supply - an investigation in Germany and Canada with respect to geology, radiometry legislation. Dissertation zur Erlangung des Grades “Doktor der Naturwissenschaften”. Johannes Gutenberh-Universität, Mainz.

[11] Siiri Suursoo, Liie Hill, Valle Raidla, Madis Kiisk, Alar Jantsikene, Nele Nilb, György Czuppon, Kaisa Putk, Rein Munter, Rein Koch, Kadri Isakar, 2017. Temporal changes in radiological and chemical composition of Cambrian-Vendian groundwater in conditions of intensive water consumption. Science of The Total Environment. Volumes 601–602, pp 679–690.

As the water supply networks of southern Estonia (Jõgeva, Põlva, Tartu, Valga, Viljandi, Võru) do not generally use the Cambrian-Vendian aqueous layer, which contains a larger amount of radium isotopes of natural origin, and based on the results of previous water samples and Estonian geological construction, the aqueous layers used by water supply networks of southern Estonia do not contain significant amounts of radium isotopes. Nevertheless, it was decided to organise the radionuclide content mapping in a centralised manner and a study [12] was conducted to obtain an overview of the radionuclide content of the groundwater layers in use in southern Estonia. During the project, the content of water radionuclides in 230 samples was analysed in southern Estonia (Valga County, Põlva County, Võru County, Tartu County, Jõgeva County, Viljandi County). The results showed that the effective dose level obtained from the consumption of drinking water produced in the public water supply systems of southern Estonia is below the control values of the parameter.

The first conscious steps to reduce the radium content of drinking water were taken in 2012 with the launch of a water treatment plant using technology specifically designed to remove radium. Within six months, it became clear[13] that the solution used would effectively reduce the content of radionuclides in drinking water, but would bring with it a new problem – the isotopes Ra-226 and Ra-228 extracted from groundwater accumulate in the filter materials used for water purification to such an extent that the filter materials must be considered as radioactive materials. The radioactive decay of Ra-228 produces the isotope Th-228 in the filter material, the activity concentration of which also exceeds the exclusion level established by law.

In order to get a better overview of the situation, the University of Tartu conducted a study "Generation of radioactive waste in water treatment plants using Cambrian-Vendian water intake" from 2014–2015 with the funding of KIK. The aim of the project[14] was to assess the proportion of water treatment plants using Cambrian-Vendian water intake and iron or manganese removal that generate radioactive waste in excess of the radionuclide exclusion levels set out in the Radiation Act. In a study involving 18 water supply systems, the activity concentrations of filtration materials for the radionuclides Ra-226, Ra-228 and Th-228 were measured and the absolute amounts of radioactive material generated were estimated. The study found that the formation of radioactive material was predominantly associated with the incorporation of Th-228 into the filter material. It was found that 11 out of 18 water supply systems exceed (as of January 2015) the exclusion level defined in the Radiation Act.

In order to develop solutions to this problem, a project[15] was carried out, during which a quantitative cost-benefit methodology was developed, on the basis of which it is possible to calculate the amount of justified costs for drinking water treatment. One of the aims of the project was to develop a methodology and compile guidelines on how to implement the health risk requirements established by Regulation No 82 of the Minister of Social Affairs of 31 July 2001 "Drinking water quality and control requirements and methods of analysis". The second goal was to find out the technical feasibility of NORM-free, radium-releasing water treatment technology. The methodology developed as a result of the study cannot be used for implementation until all the necessary input data is available for the cost-benefit analysis

[12] Environmental programme project No 49 of Environmental Investments Centre (KIK) of 2014 "Determination of radionuclide content in water from aqueduct of southern Estonia"

[13] Hill, L., Suursoo, S., Kiisk, M., Jantsikene, A., Nilb, N., Munter, R., Realo, E., Koch, R., Putk, K., Leier, M., Vaasma, T., Isakar, K., 2017. Long-term monitoring of a water treatment technology designed for radium removal – removal efficiencies and NORM formation. (Manuscript submitted to Journal of Radiological Protection).

[14] The 2015 project "Generation of radioactive waste in water treatment plants using Cambrian-Vendian water intake" of the Institute of Physics of the University of Tartu funded by KIK.

[15] 2018. Project of the Institute of Physics of the University of Tartu that has been co-financed by KIK "Development of a health risk assessment methodology for the content of drinking water radionuclides and feasibility studies for NORM-free water treatment".

developed by the project. As of 2018, the input data lacked the costs of handling NORM waste generated during the separation of radionuclides from drinking water. It is expected that, in 2019, the integrated environmental permit will be approved for one waste plant, after which it will be possible to draw more detailed conclusions on the costs of NORM waste management. The costs of NORM waste management are a prerequisite for the implementation of the health risk assessment methodology. In order to implement the methodology, the Health Board notifies drinking water handlers of the completion of the methodology and asks the handlers to make the corresponding cost-benefit calculations presented in the methodology. If necessary, as a result of calculations, the Health Board can make a proposal to drinking water handlers for the treatment of drinking water from radionuclides if this is justified.

2.5.3. Radon

Estonia is among those EU countries that exhibit an above average radon risk. In general, the concentration of radon in the indoor air of buildings located in areas with a high risk of radon, where no radon protection measures have been implemented, is high. The main reason for this is the high concentration of radon in the subsoil below the buildings, which is caused by uranium-rich subsoil rocks – Dictyonema shale, Obulus phosphorite, etc. Radon (hereinafter "Rn") is almost 7.7 times heavier than air. It diffuses from the soil into the air mainly as a result of pressure differences. The closer to the ground, the more intense is the aeration of soil air and migration of Rn into the air. In the composition of indoor air, Rn concentrates in basements and first floors of buildings, especially in vacuum conditions resulting from ventilation. From the modern medicine point of view, Rn that enters a human body through respiration is in the second place as a factor that increases the risk of lung cancer, immediately after smoking, which is in the first place. In an Rn-rich environment, Rn progeny elements start accumulating in the body, where the progeny elements will continue to decay.

The European Union has made it a priority to protect the health of workers and the general public against the dangers arising from ionising radiation. In accordance with EU Directive 2013/59/Euratom, Member States are required to adopt a national radon action plan in residential buildings, public buildings and workplaces to control the long-term risk of radon exposure from various sources, such as soil, construction materials or water.

The preparation of the National Radon Action Plan was initiated by Order No 61 of the Minister of the Environment of 18 January 2017. The National Radon Action Plan provides an overview of Estonia's radon strategy, the measures planned to meet its objectives and the results to be achieved. Through the action plan, national planning in the field of radon takes place. Similarly to the radioactive waste management action plan, it was decided to submit the National Radon Action Plan as Annex to KORAK due to the volume and partial overlap of development documents. The action plan is provided in Annex 2 to KORAK.

2.5.4. Construction materials

Measuring the content of radionuclides in construction materials is an important part of assessing the radiation of the population, as a person spends 80% of their time indoors. Sand, gravel and clay, which contain natural radionuclides, mainly ^{226}Ra, ^{232}Th and their decomposition products and ^{40}K, are used as raw materials in construction materials. Elevated indoor exposure may come from natural radionuclides in construction materials (UNSCEAR, 2000). In general, natural construction materials are characterised by their place of origin. The mean activity concentrations of ^{226}Ra, ^{232}Th and ^{40}K in the crust are 35, 30 and 400 Bq/kg, respectively. The world average annual effective dose of gamma radiation from construction materials indoors is estimated at 0.4 mSv (UNSCEAR, 1977, 1993).

The radioactivity of construction materials is regulated in Estonia by two regulations:

1) Regulation No 49 of the Minister of Economic Affairs and Communications of 26 July 2013
   "Requirements for construction materials and products and the procedure for attesting their conformity", laying down requirements for gamma radiation from construction products and requiring the activity concentration index of a construction product to be less than 1, unless, due to the intended use of the construction product, the Environmental Board authorises the use of a product with a higher level of radiation;
2) Regulation No 74 of the Minister of Economic Affairs and Infrastructure of 22 September 2014 "Requirements for road construction materials and products and the procedure for attesting their conformity", establishing the essential characteristics (including radioactive emission) of road construction materials and products used in road maintenance works on public roads that are subject to mandatory declaration by area of use and the procedure for attestation of the essential characteristics.

So far, there have been no problems with the content of natural radionuclides in construction materials of Estonian origin. In 2017, a study by the University of Tartu was completed to prepare for the transposition of the requirements of Directive 2013/59/Euratom on natural radioactive substances (NORM) into national legislation. The decay chain nuclides of U-238 and Th-232 contained in the construction materials analysed in the study or contained in the raw material of construction materials of Estonian origin, do not set any restrictions of the use of those construction materials as the I-index used for the characterisation of the building materials is significantly below the reference value of I=1. At the same time, information on imported construction or raw materials is incomplete, therefore, more attention should be paid to it in the future. Consequently, further research is needed into the radioactivity of construction materials in order to avoid the use of highly radioactive materials and the generation of subsequent (NORM) waste. Radiological studies of construction products must take into account the list of types of construction materials in Annex XIII to Directive 2013/59/Euratom for which gamma radiation is to be considered. The Directive lists the types of construction materials for which gamma radiation is to be taken into account, provides a formula for calculating the activity concentration index and sets out requirements for the calculation of gamma radiation from construction materials before they are placed on the market. The reference level obtained from gamma radiation emitted by construction materials is 1 mSv per year.

2.6. Medical exposure

Medical exposure is used in healthcare on a daily basis for the early detection, diagnosis, assessment, and treatment of diseases patients may suffer from. More than one million medical exposure procedures are performed on more than three hundred thousand people in Estonia every year. At the same time, the number of computed tomography procedures has significantly increased. The radiation dose from medical exposure, on average per capita, is more than 95% of the radiation dose from artificial exposure, and according to UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation), the average person receives an effective dose of 0.6 mSv from diagnostic medical radiology during the year. The dose from X-rays (i.e. X-rays and computed tomography) is estimated to be more than 95% of the total collective dose of medical exposure. A comparison of the most typical X-rays worldwide shows that their frequency and the proportion of the patient dose in the collective dose vary widely, with conventional chest examinations being the most common and computed tomography examinations accounting for the largest contribution in recent years. In computed tomography examinations, the effective dose received by a patient may be hundreds of times higher than that obtained with conventional X-rays.

Given the increase in the total number of medical exposure procedures and the possible radiation doses that can be obtained, it is important to ensure radiation safety in medical exposure procedures.

Training of medical staff is one of the important measures to ensure radiation safety. The use of medical exposure is directly related to radiologists, radiology technicians and medical physics experts, whose level training and regular in-service training in radiation safety are the basis for the use of optimised and justified medical exposure. Additional training must cover all medical staff to ensure evidence-based referral to medical exposure studies. The training must cover staff working in the field of radiology as well as in other areas of specialised medical care. The necessity of the training and the current situation are described in more detail in Chapter 2.2.1.

2.6.1. Patient radiation safety

To ensure radiation safety, medical exposure must be used in a reasonable and optimised way, while ensuring clinical quality.

For example, a nationwide e-health information system (hereinafter "health information system") helps to ensure the justification, allowing the relevant health care providers to quickly get an overview of the patient's diagnosis, treatment plan, medical exposure procedures and images. The availability of medical images is regulated by section 4 of Regulation No 52 of the Minister of Health and Labour of 27
27. August 2014 "Types of medical records, information technology requirements for them and conditions and procedure for making them available", according to which the images must be available through the health information system immediately after the image has been taken and the reference to the image must be identifiable from the response to the referral. It is not only the medical images that need to be directly available, which the technology used does not allow to be represented in the required form. The availability of information contributes to the validity of testing and reduces the number of repeat testing.

At the same time, attention should also be paid to the general justification of the procedure, which is particularly important when new technologies and methods enter the market. The assessment of the general justification describes the indications or other conditions under which the use of any type of medical exposure procedure can be considered justified. The general justification of medical exposure procedures can be ensured in several ways. For example, guidance on new technologies and methods may be developed, the general feasibility assessment may be carried out by an expert working group or the Commission, and the feasibility may be decided by a national agency with sufficient competence.

At present, there is no systematic system for assessing the general justification of medical exposure procedures as a guide for health care providers in ensuring that individual procedures are justified and for supervisors in verifying the targeted use of medical exposure. This was also highlighted in the audit report on the Estonian radiation protection system prepared by the IAEA in autumn 2016.

There are also no guidelines for referral to medical exposure procedures of practical value to ensure that the procedures are justified. At present, those who refer must comply with the European Commission's Radiation Protection Guide No 118. In addition, attention should be paid to training and awareness-raising for those referring.

In order to ensure optimisation, a functioning radiation safety quality system of the holder of a radiation practice licence is especially important. In addition, the establishment and updating of national diagnostic reference values, which provide reference values for the radiation practice licence holders when optimising patient doses, will contribute to optimisation. In accordance with the Radiation Act, the Health Board is engaged in diagnostic reference values and the reference values are reviewed at least once every five years. In 2018, five diagnostic reference values have been agreed: chest X-ray, direct image (PA); X-ray of the lumbar vertebrae, direct image (AP); X-ray of the lumbar vertebrae, lateral image (LAT), mammography, in the craniocaudal direction (CC) and mammography, in the transverse direction (MLO).

Greater attention needs to be paid to the reporting of unplanned cases of medical exposure, which would contribute to the analysis of cases, the identification of causes, the implementation of corrective measures and, therefore, the continuous improvement of the quality system. A system for reporting unplanned medical exposures needs to be developed and the cases to be reported should be defined more precisely. One option could be to link the notification system to the patient safety portal in the future.

In order to better assess the level of the annual population dose from medical exposure, it is necessary to know the number of procedures performed during the year. These figures must be available for specific procedures, as the radiation doses of various procedures are different and, therefore, the radiation dose cannot be estimated from their total number. Accordingly, it is necessary to ensure that data on the performance of medical exposure procedures are sent to the health information system in order to be able to collect the data required for statistics by means of the statistics module of the health information system. The Estonian Centre for Health and Welfare Information Systems (hereinafter "TEHIK") in cooperation with the Estonian Society of Radiology has reviewed the classifications of medical exposure procedures, which are subject to publication in the publication centre managed by TEHIK.

At present, the information systems of health care providers for recording medical exposure surveys have been developed according to the list of the Estonian Health Insurance Fund rather than according to the classifications of medical radiology procedures of the health information system. This, in turn, has led to a situation where the data collected on procedures can theoretically be collected through the health information system statistics module, but as suitable data is not received by the health information system, it is not possible to do so and the data must be collected manually.

In addition, it is not yet agreed which public authority would be involved in assessing the level of the annual population dose from medical exposure. There is no comprehensive statistics on the number of studies and estimated patient doses of studies performed in health care institutions, which would, in turn, allow assessing and directing general trends in the use of medical exposure and comparing Estonia with similar statistics in other countries.

2.6.2. Quality

Competent staff and continuous staff training, understanding of the process (including clear instructions) and effective equipment quality control are essential to ensure the quality of medical exposure procedures. The Environmental Board assesses the adequacy of the quality assurance system prior to the issue of a radiation practice licence. When using medical exposure in health care, the health care provider must also follow the quality requirements provided on the basis of the Health Care Services Organization Act, which are monitored by the Health Board.

The holders of radiation practice licences are obliged to perform clinical audits in order to improve quality in accordance with the European Commission guidelines on radiation protection No 159. It is possible to use an independent auditor for radiation practice – for example, the IAEA technical cooperation project conducts clinical audits to assess the use of medical exposure in health care facilities, including the activities of radiation therapy and the Department of Nuclear Medicine. Although the obligation to carry out clinical audits has been in place since 2014, there is no good overview of how many health care providers carry out clinical audits and of the quality thereof. At the same time, training opportunities for clinical audits should be created to help root the practice of clinical audits.

Mandatory radiation safety requirements to be followed when using medical exposure are set out in the Radiation Act and its implementing acts. Furthermore, the Ministry of Social Affairs has prepared guidelines for holders of radiation practice licences for the assessment of patient doses and standard procedures for medical exposure procedures. These are published on the website of the Health Board and provide additional guidelines for ensuring the patient's radiation safety when performing medical exposure procedures.

3. Strategic objectives for ensuring radiation safety

This chapter sets out the strategic objectives for radiation protection to address the shortcomings addressed in the previous chapters. In the event of indicators to reduce radiation risk, it should be clarified that it is often not possible to quantify them, for example, the percentage reduction in risk, as the magnitude of the risk cannot often be quantified. In order to achieve this objective, measures are planned, which are sets of different types of activities. The development plan provides descriptions of the most important activities necessary for the implementation of the measure. This chapter also discusses indicators that can be used to assess the achievement of objectives.

3.1. Strategic objective 1: The functioning of the radiation safety infrastructure is improved

Indicator 1. Updating of the legislation required to ensure safety standards for ionising radiation in line with international requirements

Target level by 2020: The ARTEMIS mission has been launched.

Target level by 2026: At the time of the national radiation safety audit, guidance documents and legislation have been prepared and updated on the basis of international requirements and the IRRS mission report.

3.1.1. Measure: Preparation and updating of legislation and guidance documents required to ensure safety standards arising from ionising radiation in accordance with international requirements.

Activities

1. Preparation of legislative analysis and amendment of legislation.
2. Development of procedures for organising radiation safety monitoring.
3. Preparation and conduct of international audits.
4. Establishment of the Secondary Standard Dosimetry Laboratory (SSDL).
5. Harmonisation of the basis for deriving exclusion and clearance levels for the quantities of any radionuclide-containing material.
6. Development of a national dose register for exposed workers.

3.2. Strategic objective 2: Radiation safety awareness and competence building are ensured

Indicator 1. Development of radiation training

Target level by 2027: A consistent training system for radiation specialists has been developed.

Indicator 2. Local government officials in areas with a high radon risk are aware of the dangers associated with radon and take radon risk into account when approving plans.

Target level by 2025: At least three training events have been organised for local government officials.

Indicator 3. Informing people about the possible dangers of ionising radiation and methods for reducing the risks.

Target level by 2025: At least five information days on radiation have been organised. Indicator 4. Ensuring a sufficient number of radiation specialists in Estonia.
Target level by 2020: One radiation specialist position has been created in A.L.A.R.A. AS.

Target level by 2023: Four additional radiation specialist positions have been created in the administrative area of the Ministry of the Environment.

3.2.1. Action: Development of radiation training field

Activities

1. Development of an online course on basic radiation knowledge for public administration staff.
2. Assessing the possibility of integrating a lecture course on radiation safety into the curriculum of the field of natural and exact sciences of a public law institution and finding opportunities.
3. Improving design and construction curricula in relation to the dangers of natural radiation, in particular radon, and the use of mitigation measures to raise awareness among specialists in this area.
4. Training of supervisory officials (TI and KKI).
5. Regular emergency response training for A.L.A.R.A. AS.
6. Regular radiation training for the first responders in radiation events.

3.2.2. Measure: Raising people's awareness of the potential dangers of ionising radiation and methods of reducing them

Activities

1. Organisation of radon training for local government officials in areas with increased radon risk.
2. Organisation of radiation information days for the public.
3. Compilation of web-based information materials for the population on behaviour in radiological emergencies.
4. Development and disclosure of frequently asked questions on radiological emergencies on the Internet.
5. Regular campaigns for the collection of nuclear equipment and other potentially hazardous radioactive waste and for information on radiation sources.

6. Organising emergency risk communication.

3.2.3. Measure: Ensuring a sufficient number of radiation specialists in Estonia

Activities

1. The establishment of at least one additional position in KeA for radon measurements and radon consulting, the establishment of at least two radiation inspector positions in KKI, the establishment of at least one additional position in KeM to meet EU and international obligations and in A.L.A.R.A.AS, which is responsible for radioactive waste management, the establishment of one additional radiation specialist in connection with studies on the construction of a radioactive waste disposal site and the decommissioning of the reactor sections of the former nuclear site in Paldiski.

3.3. Strategic objective 3: The risks associated with radioactive waste and its management are reduced

Indicator 1. A system for reducing the generation of radioactive waste and managing its safe intermediate storage is functioning.

Target level by 2019: The procedures for the clearance of radioactive waste have been established and coordinated.

Target level by 2021: The contaminated metal is melted. Concentrated waste from thawing has been properly treated and packaged to allow further storage at an intermediate or final storage site.

Target level by 2022: The safe inclusion of Tammiku radioactive waste storage facility has been carried out in the depository – waste has been removed from the depository, it has been decontaminated, demolished, and cleared for general use.

Target level by 2027: The safe collection of orphan sources and their consistent handling are ensured.

Indicator 2. There is a valid plan for the construction of a final radioactive waste storage site (including a strategic environmental assessment (SEA) report has been prepared) and an environmental impact assessment (EIA) has been carried out for the decommissioning of the reactor sections of the former nuclear site in Paldiski.

Target level by 2019: In order to establish a final storage site of radioactive waste, the preparation of a plan and a strategic environmental impact assessment have been prepared, and an environmental impact assessment has been initiated for the decommissioning of the reactor sections of the former nuclear site in Paldiski.

Target level by 2023: The (environmental) studies required for the establishment of a final storage site of radioactive waste and the decommissioning of the reactor sections of the former nuclear site in Paldiski have been completed.

Target level by 2027: The permits for the establishment of a disposal site have been issued.

Indicator 3. Research on the recovery and management of radioactive materials (NORMs) containing natural radionuclides has continued.

Target level by 2020: The requirements for conditional clearance from the management and storage of radioactive waste containing natural radionuclides are regulated.

Target level by 2025: In companies whose activities generate NORM waste or residues, the social and economic impacts of their management have been assessed (including possible management solutions of NORMs have been assessed).

3.3.1. Measure: Reduction of radioactive waste generation and organisation of its safe intermediate storage.

Activities

1. Management of an existing interim storage site.
2. Radioactive waste management, including the conditioning of sealed radiation sources, smelting of contaminated metal waste and development of a fleet of radioactive waste management equipment and acquisition of packaging for waste storage.
3. Safe inclusion of Tammiku radioactive waste storage facility.
4. Development of waste management quality management system.
5. Development of a waste characterisation system for the determination of alpha and beta emitters.
6. Development of procedures for the clearance of radioactive waste.
7. Development and operation of a management system for orphan sources.

3.3.2. Measure: Preparation of a plan for the construction of a radioactive waste disposal site (including SEA) and assessment of the environmental impact of the decommissioning of the reactor sections of the former nuclear site in Paldiski.

Activities

1. Initiation of a plan and the SEA procedure for the construction of a final radioactive waste storage site.
2. Initiation of the environmental impact assessment (EIA) of the decommissioning of the reactor sections of the former nuclear site in Paldiski.
3. Commissioning of studies required for the construction of a final radioactive waste storage site and the decommissioning of the reactor sections of the former nuclear site in Paldiski.
4. Development and implementation of a communication strategy for the construction of the final storage site and the decommissioning of the reactor sections.
5. Application for activity licences for the establishment of a final storage site and for the decommissioning of the reactor sections.
6. Design and construction of a final storage site.

3.3.3. Measure: Development of recovery and handling of radioactive material (NORMs) containing natural radionuclides and establishment of storage procedures.

Activities

1. Updating of legislation in the area of NORM.
2. Supporting research and development in the field of NORM handling for the development of the best possible technology and the creation of a NORM handling system, including the development of handling solution conditions.

3.4. Strategic objective 4: Preparedness for the prevention and resolution of radiation events is ensured

Indicator 1. A plan for resolving radiological emergencies has been prepared and planned preparedness is ensured.

Target level by 2022: The radiological emergency risk assessment and the resulting radiation emergency response plan (HOLP) are up-to-date.

3.4.1. Measure: Preparation of a radiation emergency response plan (HOLP) and ensuring planned preparedness.

Activities

1. Preparation of a radiological emergency plan describing an event with two different scenarios.
2. Participation in and organisation of exercises in the field of radiation or nuclear accidents.
3. Ensuring the operation and continuity of the early warning system.
4. Renewal of the base of measuring instruments and protective equipment of the Environmental Board.
5. Renewal of the base of measuring instruments of the Environmental Inspectorate.
6. Base of measuring instruments and protective equipment of the Rescue Board, renewal of the base of measuring instruments and equipment necessary for decontamination.
7. Renewal of the base of measuring instruments and protective equipment of the Tax and Customs Board.
8. Upgrading of the base of measuring instruments and equipment necessary for decontamination of A.L.A.R.A. AS, which is engaged in the elimination of the emergency radiation situation.
9. Development of the 13/7 responsiveness of A.L.A.R.A. AS into a 24/7 responsiveness.

3.5. Strategic objective 5: The risks from natural radiation sources of radiation are reduced

Indicator 1. Reduction of risks from natural radiation sources.

Target level by 2020: A database of radon measurements has been developed and is being maintained.

Target level by 2027: Radon areas in the entire territory of Estonia have been mapped.

3.5.1. Measure: Minimising hazards from natural radiation sources

Activities

1. Mapping of areas in need of further research in termsof radon risk and development of research methodology.
2. Carrying out radon surveys of ground air and indoor air.
3. Development of the database of radon measurement results.
4. Studying the correlation between the radon concentration of soil air and indoor air, once the amount of measurement data of measurements conducted in indoor air and in the soil air of the same plot of land increases.

5. Assessing the feasibility of an epidemiological study to investigate the association between radon and lung cancer.
6. Conducting a survey to find out people’s awareness of radon.
7. Updating of the radon measuring equipment of the Environmental Board.
8. Taking radon into account in support programmes for the reconstruction of small houses and apartment buildings.
9. Carrying out additional radiological examinations of construction materials.
10. Monitoring the implementation of the Drinking Water Regulation No 82 in relation to exceeding the reference value for radiological parameters.
11. Monitoring of the radioactivity of Sillamäe radioactive tailing pond.

3.6. Strategic objective 6: Reasonable use and radiation safety of medical exposure are ensured

<u>Indicator 1.</u> Establishing a sustainable and coherent regime for assessing the justification of medical exposure procedures.

Target level by 2020: A strategy (directions) for the justification of medical exposure procedures has been agreed.

Target level by 2022: Criteria for assessing the validity of medical exposure procedures have been agreed and published.

Target level by 2022: Additional in-service training opportunities have been created for those referring to medical exposure procedures.

<u>Indicator 2.</u> In the clinical use of medical exposure, there is a promotion of radiation awareness, the use of good practices and compliance with the principles of radiation safety, as well as the development and supervision of relevant instructional and information materials.

Target level by 2020: An institution with expertise in the field of clinical quality of medical exposure has begun to promote the clinical quality of medical exposure.

Target level by 2022: Clinical audits of medical exposure procedures are performed to a high standard and on a regular basis.

<u>Indicator 3.</u> Promoting the competence to conduct clinical audits of medical exposure procedures.

Target level by 2020: Training has been started to carry out clinical audits of medical exposure procedures and opportunities have been created for health care providers to acquire the know-how.

Target level by 2022: The necessary knowledge and resources are available to perform clinical audits.

<u>Indicator 4.</u> Introduction of annual population dose assessment from medical exposure.

Target level by 2022: The health information system receives information on the medical exposure procedures performed on the basis of the classification of radiological examinations.

Target level by 2022: In order to assess the level of the annual population dose from medical exposure, data is collected through the statistics module of the health information system.

3.6.1. Measure: A sustainable and coherent arrangement has been identified to assess the justification for medical exposure procedures

Activities

1. Negotiations with the parties, as a result of which a solution suitable for Estonia will be agreed in order to ensure the general justification of medical exposure procedures.
2. Identification of further actions, depending on the appropriate solution, to ensure a consistent assessment of the overall justification.

3.6.2. Measure: In the clinical use of medical exposure, there is a promotion of radiation awareness, good practice and adherence to the principles of radiation safety, and the development and monitoring of relevant guidance and information materials.

Activities

1. The establishment of diagnostic reference values, ensuring regular review, collection of additional data needed to establish and review the DRL, updating guidance material to collect diagnostic reference values as necessary. Review of reference procedures by 2020.
2. Establishment of the action plan. On the basis of the action plan, compliance with the provisions of the Regulation of the Minister of Health and Labour of 19 December 2018 "Radiation safety requirements for medical exposure procedures, requirements for clinical audit of medical exposure procedures and diagnostic reference values and requirements for their determination" concerning the clinical quality of the use of medical exposure will be monitored, introduced and promoted.

3.6.3. Measure: Promoting the competence to conduct clinical audits of medical exposure procedures.

Activity

1. Training of training providers for clinical auditors.

3.6.4. Measure: The introduction of an assessment of the level of theannual population dose resulting from medical exposure.

Activities:

1. Introduction of the classification by health care providers and development of the health information system statistics module.
2. Determination of the agency responsible for assessing the level of the annual population dose from medical exposure, subject to restrictions on access to the statistical module of the health information system.

4. Description of management structure

This chapter describes the organisation of the implementation of the development plan, cooperation and division of roles for the achievement of radiation protection objectives, the organisation of the assessment of the effectiveness of radiation protection policy, and receiving feedback on the effectiveness and efficiency of the measures used to implement the development plan.

4.1. Division of roles of agencies participating in the implementation of the development plan

The main performers of the development plan are the Ministry of the Environment, the Environmental Board, the Environmental Inspectorate, the Ministry of Social Affairs, the Ministry of the Interior and A.L.A.R.A. AS, therefore, it is not possible to appoint a main person responsible for each objective. At the same time, it can be highlighted that the Ministry of the Environment is responsible for coordinating radiation safety activities more generally, specifying the tasks of agencies involved in radiation safety activities, organising the establishment or amendment of radiation legislation, participating in resolving radiation emergencies and raising awareness. The Environmental Board manages the resolution of radiological emergencies and the preparation of an emergency response plan, it is responsible for providing relevant information in the event of an emergency (through monitoring systems, modelling and calculations), raising people's awareness through organising information days and compiling information materials, participates in work concerning medical exposure and advises the Ministry of Environment. The Ministry of the Interior organises activities related to the area of internal security, public order, border guard, rescue, emergency alerts and crisis management, and coordinates the participation of its subordinate agencies (Alarm Centre, Rescue Board, Police and Border Guard Board, Security Police Board) in radiation events. A.L.A.R.A. AS is an agency that is engaged in the safe storage of radioactive waste in Estonia, and also has the capacity to eliminate radioactive contamination caused or found in radiological emergencies or in the course of radiological incidents.

The Ministry of the Environment is responsible for the general fulfilment of the objectives of the development plan. The division of roles of the agencies participating in the implementation of the development plan is described in more detail in the implementation plan provided in Annex 3, where separate responsible persons have been appointed for the implementation of the activities of the development plan.

4.2. Evaluation of the effectiveness of the development plan

Once every two years, the Ministry of the Environment organises an assessment of the effectiveness of the development plan. To this end, an interim period on the implementation of KORAK, the achievement of the objectives and effectiveness set out in the development plan and the implementation plan will be prepared with the assistance of the ministries involved in the establishment of the development plan and the agencies governed by them.

The effectiveness of the development plan is also assessed by the implementation plan, which is discussed in Annex 3. It indicates the time of the activity, its immediate result, as well as the implementers. The objectives, activities and results set out in the development plan must be reviewed after the expiry of the first implementation plan in 2021. Activities that have not been carried out but are still relevant for achieving radiation safety must be addressed in the new implementation plan with other activities planned in the development plan and starting or continuing in 2022. If by that time significant changes have taken place in the area of radiation safety and activities that are not covered by the development plan occur, the implementation plan will take this into account and, if necessary, initiate the renewal of the development plan.

5. Cost estimate of the development plan for the period 2018–2021

As part of this development plan, a cost forecast was prepared for the implementation plan period 2018–2021. The resources, funding sources and opportunities required for the implementation of the implementation plan were estimated.

The implementation plan for the first period of the development plan (2018–2021) determines approximately 60 activities.

It is not possible to quantify the economic revenue received from the implementation of the development plan, as the revenue received is long-term and mostly indirect (e.g. better human health).

The cost estimate of the activities arising from the implementation plan has been prepared by the following sub-objectives, adhering to the general structure of the development plan:

- the functioning of the radiation safety infrastructure is improved;
- the radiation safety awareness and competence increase are ensured;
- the risks associated with radioactive waste and its management are reduced;
- preparedness for the prevention and resolution of radiation events is ensured;
- the risks from natural sources of radiation are reduced;
- the justified use of medical exposure and radiation safety are ensured.

All sub-objectives are addressed in the implementation plan by sub-themes, as they require a systemic approach, and the scope of the planned activities is large.

In order to prepare a cost estimate for the implementation plan, the measures and activities required to meet the strategic objectives were defined. Table 1 and Annex 3 to KORAK provide an estimate of the cost of implementing the implementation plan, which includes a breakdown of the cost by year and an estimated total cost. The cost estimate is based on the prices of the base year 2018, as it was found to be more expedient in case of a multi-agency development plan. All costs are included with VAT.

The cost estimate does not reflect the costs of the Ministry of the Interior and the Ministry of Social Affairs. The budget of the Ministry of Social Affairs is planned in the programmes of the population health development plan.

In the area of radiation, several projects are being implemented and are planned to be implemented with the support of foreign investments. The source of external financing depends on the nature of the planned projects, mainly the European Commission's Structural Funds and the IAEA Technical Cooperation Fund, which are used to apply for external financing.

Annex 3 and Table 1 show that during the period of validity of the implementation plan, from 2018–2021, the planned resources amount to approximately EUR 11 million. The total cost of the development plan in the prices of 2018 between 2018–2027 is approximately EUR 30 million. The largest estimated expenditures are expected to reduce the risks associated with radioactive waste management (including to carry out the research necessary for the construction of a radioactive waste disposal site, as well as to design and construct such a site) and several large-scale external assistance projects are planned.

Abbreviations used in Table 1 [translator's comment: In order to avoid confusion, the following abbreviations have been provided in the same form as they appear in Estonian]:

- KeM – Ministry of the Environment
- KeA – Environmental Board
- KKI – Environmental Inspectorate

- PPA – Police and Border Guard Board
- PäA – Rescue Board
- MKM – Ministry of Economic Affairs and Communications
- SiM – Ministry of the Interior
- RaM – Ministry of Finance
- MTA – Tax and Customs Board
- EGT – Estonian Geological Service
- TI – Labour Inspectorate
- KIK – Foundation Environmental Investments Centre
- KEMIT – Information Technology Centre of the Ministry of the Environment
- TervA – Health Board
- A.L.A.R.A. AS – State-owned company under the administration of the Ministry of Economic Affairs and Communications, with its main activity being the management and decontamination of the former nuclear site in Paldiski and Tammiku radioactive waste storage facility; the management and storage of radioactive waste generated in Estonia; the development and implementation of radioactive waste management projects; the provision of services in the areas of measurement of radioactivity and radioactive contamination and decontamination of radioactive contamination.
- Ökosil AS – An environmental company established by the Estonian state and Silmet Grupp AS, whose task is to manage major environmental projects, including the environmental reorganisation project of Sillamäe radioactive tailing pond, and to provide services related to environmental management and monitoring.

Table 1. Estimated cost of implementing KORAK in the period 2018–2021

No	Objective/measure	EA type	Responsible body (organisation)	TOTAL, EUR	2018, EUR	2019, EUR	2020, EUR	2021, EUR
Objective 1	**The functioning of the radiation safety infrastructure has been improved**			**610,230**	**4,386**	**358,844**	**225,000**	**22,000**
Measure 1.1	Preparation and updating of legislation and guidance documents required to ensure safety standards arising from ionising radiation in accordance with international requirements	VF, RE, KIK	KeM, KeA, KKI, A.L.A.R.A.	610,230	4,386	358,844	225,000	22,000
Objective 2	**Radiation safety awareness and competence building are ensured**			**265,395**	**1,895**	**67,500**	**107,500**	**82,500**
Measure 2.1	Development of radiation training	RE	KeA, PPA, PäA,TervA, KeM, MKM, A.L.A.R.A.	92,000	1,000	25,000	41,000	25,000
Measure 2.2	Raising people's awareness of the potential dangers of ionizing radiation and methods of reducing them	RE	KeM, KeA, A.L.A.R.A	20,395	895	16,500	1,500	1,500
Measure 2.3	Ensuring a sufficient number of radiation specialists in Estonia	RE	KeM, KeA; KKI; A.L.A.R.A.	147,000	0	26,000	65,000	56,000

No	Objective/measure	EA type	Responsible body (organisation)	TOTAL, EUR	2018, EUR	2019, EUR	2020, EUR	2021, EUR
Objective 3	**The risks associated with radioactive waste and its management have been reduced**			**7,751,000**	**498,000**	**1,249,000**	**1,609,000**	**4,395,000**
Measure 3.1	Reduction of radioactive waste generation and organisation of its safe intermediate storage	RE, VF, KIK	MKM, A.L.A.R.A. SiM, KeM KeA, KKM	3,395,000	482,000	494,000	774,000	1,645,000
Measure 3.2	Preparation of a plan for the construction of a radioactive waste disposal site (including SEA) and assessment of the environmental impact of the decommissioning of the reactor sections of the former nuclear site in Paldiski	VF	RaM, KeM, MKM, KeA, A.L.A.R.A.	4,156,000	16,000	755,000	735,000	2,650,000
Measure 3.3	Development of the recovery and handling of radioactive material (NORMs) containing natural radionuclides and establishment of storage procedures	VF/ KIK	KeA, KeM	200,000	0	0	100,000	100,000
Objective 4	**Preparedness for the prevention and resolution of radiation events is ensured**			**2,257,400**	**2000**	**181,500**	**1,773,400**	**300,500**

No	Objective/measure	EA type	Responsible body (organisation)	TOTAL, EUR	2018, EUR	2019, EUR	2020, EUR	2021, EUR
Measure 4.1	Preparation of a radiation emergency response plan (HOLP) and ensuring planned preparedness		KEM, KeA, SiM, PäA, KKI, RaM, MTA, MKM,A.L.A.R.A.	492,400	2,000	181,500	28,400	280,500
Objective 5	**Risks from natural sources of radiation have been reduced**			**1,879,780**	**70,780**	**223,000**	**883,000**	**703,000**
Measure 5.1	Minimising hazards from natural radiation sources	KIK, RE	KeM, KeA, EGT, KKI, TI, KEMIT, MKM, TA, KKM; AS Ökosil	1,879,780	70,780	223,000	883,000	703,000
Objective 6	**Reasonable use and radiation safety of medical exposure are ensured**			**56,000**	**0**	**0**	**30,000**	**26,000**
Measure 6.1	A sustainable and coherent arrangement has been identified to assess the justification for medical exposure procedures		SoM, KeA	20,000	0	0	10,000	10,000

No	Objective/measure	EA type	Responsible body (organisation)	TOTAL, EUR	2018, EUR	2019, EUR	2020, EUR	2021, EUR
Measure 6.2	In the clinical use of medical exposure, there is a promotion of radiation awareness, good practice and adherence to the principles of radiation safety, and the development and monitoring of relevant guidance and information materials.		TervA, KeA, KKI	16,000	0	0	10,000	6,000
Measure 6.3	Promoting the competence to conduct clinical audits of medical exposure procedures		KeA, SoM, TervA	20,000	0	0	10,000	10,000
Measure 6.4	Introduction of annual population dose assessment from medical exposure		SoM, KeM	0	0	0	0	0
TOTAL				**11,073,805**	**577,061**	**2,079,844**	**2,882,900**	**5,534,000**

6. Strategic environmental assessment and process disclosure

6.1. Strategic environmental assessment

The strategic environmental assessment (hereinafter "SEA") was carried out by a group of experts from Alkranel OÜ, who operated in parallel with the working group engaged in the preparation of KORAK. The SEA expert group made proposals to the KORAK working group on the preparation of the development plan, and the group of experts also received some important substantive comments, which were included in the development plan. A more detailed overview of the KORAK SEA is available in the Strategic Environmental Assessment Report of the National Radiation Safety Development Plan 2018–2027.

6.2. Disclosure

In accordance with the Environmental Impact Assessment and Environmental Management System Act, a public display of the programme was organised to introduce the SEA programme, followed by a public discussion. The public display of the SEA programme took place from 5 July–14 August 2017 and the public discussion of the programme on 15 August 2017.

In accordance with the Environmental Impact Assessment and Environmental Management System Act, the publication of the strategic environmental assessment report of the development plan was organised with a public discussion. The public display took place at the same time as the disclosure of KORAK from 14 August–27 September 2019 and the public discussion on 3 October 2019.

During the disclosure and public discussion in Estonia, no questions, suggestions or comments were submitted with regard to the environmental impact assessment report or the development plan.

In connection with the possibility of transboundary effects, the Ministry of the Environment notified Finland, Sweden, Denmark, Germany, Poland, Lithuania, Latvia and Russia of the SEA process on 31 July 2019.

Denmark and **Lithuania** do not want to be involved in the further process. **Poland** does not want to be involved in the SEA process, but would like to receive information and relevant documents on further activities with possible transboundary effects. **Latvia** also does not want to be involved in the SEA process, but wants to be informed if the disposal site should be planned not in Paldiski but in another part of Estonia, especially if it is closer to the Latvian border than Paldiski.

Sweden wants to participate in this SEA process and in the planning and environmental impact assessment of further activities under the development plan that may have transboundary effects (e.g. decommissioning of the Paldiski reactor sections and the construction of a radioactive waste disposal site).

Finland also wants to participate in this SEA process and in further activities under the development plan, which may include transboundary effects in planning and assessing the environmental impact. At the same time, the Finnish Ministry of Economic Affairs and Employment considers that transboundary impacts related to the final storage site are unlikely, as the final storage site is planned for the storage of low or intermediate level radioactive waste.

Summary

The development plan determined six areas that are important for development at least in the next ten years. The current situation in these areas has been analysed, and the main problems and opportunities have been presented. The development plan set six long-term objectives, defined the indicators for achieving the objectives, and planned the necessary directions of action in more detail.

The objectives of the development plan and the measures planned to achieve them are briefly as follows:

- **The functioning of the radiation safety infrastructure has been improved**

Measures: Preparation and updating of legislation and guidance documents required to ensure safety standards arising from ionising radiation in accordance with international requirements.

- **Radiation safety awareness and competence building are ensured**

Measures: Development of radiation training; raising people's awareness of the potential dangers of ionising radiation and methods of reducing them; ensuring a sufficient number of radiation specialists in Estonia.

- **The risks associated with radioactive waste and its management have been reduced**

Measures: Reduction of radioactive waste generation and organisation of its safe intermediate storage; preparation of a plan for the construction of a radioactive waste disposal site (including SEA) and assessment of the environmental impact of the decommissioning of the reactor sections of the former nuclear site in Paldiski; development of the recovery and handling of radioactive material (NORMs) containing natural radionuclides and establishment of storage procedures.

- **Preparedness for the prevention and resolution of radiation events is ensured**

Measure: Preparation of a radiation emergency response plan (HOLP) and ensuring planned preparedness.

- **Risks from natural sources of radiation have been reduced**

Measure: Minimising hazards from natural radiation sources.

- **Reasonable use and radiation safety of medical exposure are ensured**

Measures: a sustainable and coherent organisation has been identified to assess the justification for medical exposure procedures; in the clinical use of medical radiation, there is a promotion of radiation awareness, the use of good practices and compliance with the principles of radiation safety, the development and supervision of relevant guidance and information materials; promotion of the competence to conduct clinical audits of medical exposure procedures; introduction of an assessment of the level of the annual population dose from medical exposure.

The development plan schedules financial resources for ongoing and new operations. For this purpose, a cost forecast for the development plan for 2018–2027 and an implementation plan with a validity of four years (including the base year) for 2018–2021 have been prepared. In order to ensure radiation safety in Estonia, the areas in need of priority funding are the following: reducing the risks associated with radioactive waste management, ensuring preparedness for the prevention and resolution of radiation events, reducing the effects of

human and natural and medical exposure. The development plan allocates resources for decision-making at the national level. The development plan cannot set out the resources that must be provided by local governments, companies or people themselves. For example, money cannot be planned from the state budget to reduce the health risk arising from ionising radiation or to take radon measurements during the construction or renovation of buildings. However, the aim of the development plan is to do everything so that specialists, entrepreneurs, and residents are aware of the problems and are able to minimise the risks.

The total cost of the development plan in the prices of 2018 between 2018–2021 is approximately EUR 11 million. The largest percentage of the planned and already available resources will be used to reduce the risks associated with radioactive waste management, and a number of large-scale external assistance projects are planned to implement there.

In accordance with the Environmental Impact Assessment and Environmental Management System Act, a strategic environmental impact assessment of this development plan was performed and the disclosure of the development plan and SEA report was organised. SEA is mandatory as the activities planned on the basis of KORAK, the National Radon Action Plan and the National Action plan for Radioactive Waste Management are expected to have a significant environmental impact. In order to find a strategic environmental impact assessor, a simple tender was organised, as a result of which experts from Alkranel OÜ were selected as the impact assessors. The group of experts made several proposals to the KORAK working group for the preparation of a development plan, as well as received some important substantive comments from the group of experts, which were taken into account in the development plan. Relevant comments were received from interested parties during the disclosure of the documents and the public consultation, which were also taken into account in the preparation of both the development plan and the SEA report.

Once every two years, the Minister of the Environment issues an order approving the report on the achievement and effectiveness of the objectives set out in the implementation plan. The objectives, activities and implementation results set out in the development plan will be reviewed after the expiry of the implementation plan of the development plan in 2021.

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Annex 1. National Action Plan for Radioactive Waste Management

Annex 2. National Radon Action Plan

Annex 3. Implementation Plan of the National Radiation Safety Development Plan 2018–2021