EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY

DIRECTORATE D – Nuclear energy, safety and ITER
D.3 – Radiation protection and nuclear safety

Technical Report on Verification under the terms of Article 35 of the Euratom Treaty

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LITHUANIA

Routine and emergency radioactivity monitoring arrangements
Monitoring of radioactivity in drinking water and foodstuffs

29 November – 1 December 2016

Reference: LT 16-06

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35

OF THE EURATOM TREATY

FACILITIES:	Routine and emergency radioactivity monitoring arrangements Monitoring of radioactivity in drinking water and foodstuffs
LOCATIONS:	Vilnius, Buivydžiai
DATES:	28 November – 1 December 2016
REFERENCE:	LT 16-06
TEAM MEMBERS:	Mr V. Tanner (team leader) Mr S. McAllister
REPORT DATE:	25 April 2017
SIGNATURES:	

V. Tanner S. McAllister

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TECHNICAL REPORT

1 INTRODUCTION

Under Article 35 of the Euratom Treaty, all Member States must establish the facilities necessary to carry out continuous monitoring of the levels of radioactivity in air, water and soil and to ensure compliance with basic safety standards[1]. Article 35 also gives the European Commission the right of access to such facilities to verify their operation and efficiency. The radiation protection and nuclear safety unit of the European Commission's Directorate-General for Energy is responsible for undertaking these verifications. The Joint Research Centre Directorate-General provides technical support during the verification visits and in drawing up the reports.

The main purpose of the verifications under Article 35 of the Euratom Treaty is to provide an independent assessment of the adequacy of monitoring facilities for:

- liquid and airborne discharges of radioactivity from a site into the environment;
- levels of environmental radioactivity at the site perimeter and in the marine, terrestrial and aquatic environment around the site, for all relevant pathways;
- levels of environmental radioactivity on the territory of the Member State.

Taking into account previous bilateral protocols, a Commission Communication[2] describing practical arrangements for Article 35 verification visits in Member States was published in the *Official Journal of the European Union* on 4 July 2006.

2 PREPARATION AND CONDUCT OF THE VERIFICATION

2.1 PREAMBLE

The Commission notified Lithuania of its decision to conduct an Article 35 verification in a letter addressed to the Lithuanian Permanent Representation to the European Union. The Lithuanian Government subsequently designated the Environmental Protection Agency (EPA) to lead the preparations for this visit.

This verification followed up on the 2011 visit, after which the Commission issued several recommendations[3]. Lithuania subsequently set out its corresponding improvement measures in two verification follow-up reports[4,5].

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1 Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation (OJ L 159, 29.6.1996, replaced by Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom (OJ L 13, 17.1.2014, p. 1).

2 Commission Communication *Verification of environmental radioactivity monitoring facilities under the terms of Article 35 of the Euratom Treaty — Practical arrangements for the conduct of verification visits in Member States* (OJ C 155, 4.7.2006, pp. 2-5).

3 Article 35 Technical Report LT-11/05, 23 December 2011.

4 Intermediate report by the Environmental Protection Agency on implementation of the recommendations presented in the Technical Report on verification under the terms of Article 35 (No (4.4)-A4-3909, 10 December 2012).

5 Final report on by the Environmental Protection Agency on implementation of the recommendations presented in the Technical Report on verification under the terms of Article 35, (No (4.4)-A4-8674, 30 December 2014).

2.2 DOCUMENTS

To assist the verification team in its work, the national authorities supplied an information package in advance[6]. Additional documentation was provided during and after the visit. The information thus provided was used extensively in drawing up the descriptive sections of the report.

2.3 PROGRAMME OF THE VISIT

The Commission and the EPA discussed and agreed on a programme of verification activities in line with the Commission Communication of 4 July 2006.

The opening meeting included presentations on Lithuania's new early warning network, RADIS, and other environmental monitoring arrangements. The verification team pointed to the quality and comprehensiveness of all the presentations and documentation.

The team carried out the verifications in accordance with the programme in Appendix 1. It met the following representatives of the national authorities and other parties involved:

Environmental Protection Agency Juozapavičiaus St. 9, LT-09 311 Vilnius Phone +370 70662008, fax +370 70662000	
Director Deputy Director	Mr Robertas Marteckas Mr Vytautas Krusinskas
Environmental Research Department	Ms Rasa Juodvalkiene, Director of Department
Radiology Division	Dr Beata Vilimaite Silobritiene, Head of Division
	Dr Rasa Morkuniene, Chief specialist
	Ms Laimute Jociene, Senior specialist
	Ms Irena Sliuozaite, Senior specialist
Automatic Measurement Systems Division	Mr Juozas Molis, Head of Division
	Ms Olga Useliene, Chief specialist
Radiation Protection Centre Kalvariju St. 153, LT-08 221, Vilnius Phone +370 52361936, Fax +370 52763633, e-mail: rsc@rsc.lt	
Director Deputy Director	Mr Albinas Mastauskas Ms Ramunė Marija Stasiūnaitienė
Department of Expertise and Exposure Monitoring	Mr Julius Žiliukas, Director of Department
Division of Public Exposure Monitoring at the Department of Expertise and Exposure Monitoring	Dr Rima Ladygienė, Head of Division
	Dr Auksė Tankeviciute, Chief specialist
	Dr Laima Pilkytė, Chief specialist
	Dr Asta Orentienė, Chief specialist
	Mr Remigijus Kievinas, Chief specialist
	Ms Vida Žukauskaitė, Senior specialist
Division of Occupational Exposure Monitoring at the Department of Expertise and Exposure Monitoring	Ms Ausra Urboniene, Head of Division

6 Replies to the preliminary information questionnaire addressed to the national competent authority, received on 3 November 2016.

National Food and Veterinary Risk Assessment Institute J. Kairiuksčio St. 10, LT-08 409, Vilnius Phone +370 52780470, fax +370 52780471, e-mail: nmvrvi@vet.lt			
	Director	Dr Gediminas Pridotkas	
	Chemistry unit	Ms Inga Jarmalaite, Head of Unit	
	Radiology group of Chemistry unit	Mr Pranas Drulia, Advisor	

3 LEGAL FRAMEWORK FOR RADIOACTIVITY MONITORING

3.1 LEGISLATIVE ACTS REGULATING ENVIRONMENTAL RADIOACTIVITY MONITORING

Lithuania has comprehensive legislation covering radiation protection in general and radiological monitoring of the environment, foodstuffs and discharges in particular. The majority of the legislation has been adopted or updated recently.

- Law on environmental monitoring (No VIII-529, 1997, last amended in 2016)
- Law on radiation protection (No VIII-1019, 1999, last amended in 2016)
- Law on nuclear energy (No I-1613, 1996, last amended in 2014)
- Law on nuclear safety (No XI-1539, 2011, last amended in 2016)
- Law on the management of radioactive waste (No VIII-1190, 1999, last amended in 2014)
- Government Resolution No 99 (2012) on the State Public Protection Plan in case of a nuclear accident
- Government Resolution No 315 (2011) on the approval of the National Environmental Monitoring Programme 2011-2017
- Government Resolution No 280 (2005, last amended in 2013) on approval of the rules on the handling of orphan ionising radiation sources, substances of the orphan nuclear fuel cycle, orphan nuclear and fissile substances and objects contaminated with radionuclides
- Government Resolution No 388 (2004, last amended in 2016) on approval of the procedure for the submission of reports concerning the implementation of European environmental protection legislation to the European Commission and the European Chemical Materials Agency, and on the supply of information needed to draft reports to the European Environmental Protection Agency
- Government Resolution No 578 (1998) on approval of the general regulations for dosimetric control in case of a radiation accident
- Government Resolution No 653 (1999, last amended in 2004) on approval of the licensing rules for practices involving ionising sources
- Government Resolution No 559 (2002) on approval of the public information procedure in case of a radiological or nuclear emergency
- Government Resolution No 1503 (2010) on approval of the State Emergency Management Plan
- Order No 528/490 of the ministers for health and the environment (2002, last amended in 2004) on approval of the procedure for the organisation and implementation of State environmental radiological monitoring and information provision to State and local institutions, the European Commission and the public
- Order No V-312 of the minister for health (2004) on approval of the requirements for the radiological monitoring of foodstuffs and concentrations of radionuclides in atmospheric precipitation, and the monitoring of gamma dose equivalent in the Kupiškis and Ignalina districts
- Order No 584/486 of the minister for health (2003) on the approval of regulations for sampling in case of a nuclear or radiation accident

- Order No D1- 546 of the minister for the environment (2009, last amended in 2014) on approval of the regulation of environmental monitoring of economic entities
- Hygiene standard HN 24:2003, 'Safety and quality requirements for drinking water'
- Hygiene standard HN 73:2001, 'Basic standards for radiation protection'
- Hygiene standard HN 85:2011, 'Natural exposure; standards for radiation protection'
- Hygiene standard HN 99:2011, 'Protective measures for the population in case of a radiation or nuclear accident'
- Hygiene standard HN 112:2001, 'Requirements for monitoring of internal exposure'.

3.2 LEGISLATIVE ACTS REGULATING RADIOLOGICAL SURVEILLANCE OF FOODSTUFFS

The following legal acts regulate the radiological surveillance of foodstuffs in Lithuania:

- Order No 528/490 of the ministers for health and the environment (2002, last amended in 2004) on approval of the procedure for the organisation and implementation of State environmental radiological monitoring and information provision to State and local institutions, the European Commission and the public
- Order No V-312 of the minister for health on approval of the requirements for the radiological monitoring of foodstuffs and concentrations of radionuclides in atmospheric precipitation, and the monitoring of gamma dose equivalent in the Kupiškis and Ignalina districts
- Order No V-900 of the minister for health on approval of the procedure for issuing permits for the release of radionuclides into the environment from medical, industrial (except nuclear energy facilities), agricultural and research entities
- Order No V-1091 of the minister for health (2012) on the approval of the procedure for the radiological monitoring of foodstuffs and drinking water of Nuclear Facilities

3.3 LEGISLATIVE ACTS REGULATING RADIOLOGICAL SURVEILLANCE OF DRINKING WATER

In 2016, Lithuania transposed Council Directive 2013/51/Euratom of 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[7].

3.4 INTERNATIONAL LEGISLATION AND GUIDANCE DOCUMENTS

The list below includes the main international legislation and guidance documents issued by the International Atomic Energy Agency, the International Commission on Radiological Protection and the European Union that form the basis for environmental radioactivity monitoring, the radiological surveillance of foodstuffs and the radiological surveillance of hospital discharges.

- EURATOM Treaty (1957)
- Convention on Nuclear Safety
- Convention on Early Notification of a Nuclear Accident
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency
- Helsinki Convention
- Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom

[7] Order No V-1278 of the minister for health of the Republic of Lithuania of 11 November 2015 amending Order No V-455 of 23 July 2003 approving Lithuanian hygiene standard HN 24:2003, 'Safety and quality requirements for drinking water'.

- Council Directive 2013/51/Euratom of 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
- Commission Recommendation 2000/473/Euratom of 8 June 2000 on the application of Article 36 of the Euratom Treaty concerning the monitoring of the levels of radioactivity in the environment for the purpose of assessing the exposure of the population as a whole
- Council Regulation (EC) No 733/2008 of 15 July 2008 on the conditions governing imports of agricultural products originating in third countries following the accident at the Chernobyl nuclear power station
- Commission Implementing Regulation (EU) No 322/2014 of 28 March 2014 imposing special conditions governing the import of feed and food originating in or consigned from Japan following the accident at the Fukushima nuclear power station
- *Radiation Protection and Safety of radiation Sources: International Basic Safety Standards*, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna, 2014
- *Clearance of materials resulting from the use of radionuclides in medicine, industry and research*, IAEA-TECDOC-1000, IAEA, Vienna, 1998
- *Generic models for use in assessing the impact of discharges of radioactive substances to the environment*, Safety Reports Series No 19, IAEA, Vienna, 2001
- *Handbook of parameter values for the prediction of radionuclide transfer in temperate environments*, Technical Reports Series No 364, IAEA, Vienna, 1994
- *International basic safety standards for protection against ionizing radiation and for the safety of radiation sources*, Safety Series No 115, IAEA, Vienna, 1996
- *Management of radioactive waste from the use of radionuclides in medicine*, IAEA-TECDOC-1183, IAEA, Vienna, 2000
- *Regulatory control of radioactive discharges to the environment: Safety Guide*, Safety Standards Series No. WS-G-2.3, IAEA, Vienna, 2000
- *Sources and effects of* ionizing *radiation*, United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) 2000 Report to the General Assembly, Vol. I, United Nations, New York, 2000
- Council Directive 96/23/EC of 29 April 1996 on measures to monitor certain substances and residues thereof in live animals and animal products and repealing Directives 85/358/EEC and 86/469/EEC and Decisions 89/187/EEC and 91/664/EEC

4 BODIES HAVING COMPETENCE IN THE FIELD OF ENVIRONMENTAL RADIOACTIVITY MONITORING

4.1 ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA), operating under the Ministry of the Environment, monitors radioactivity in air aerosols, deposition and surface water (water, bottom sediments and biota) and has a network of automatic gamma dose rate measurement stations. It does so as part of the National Environmental Monitoring Programme. The EPA is the institution responsible for drafting regulations dealing with the environmental monitoring of economic entities, with checks on environmental monitoring conducted by economic entities, with the quality of monitoring data and with the compliance of applied methods with legal acts as set out in the Law on Environmental Monitoring. It also submits the report on national radiological monitoring to the European Commission.

4.2 RADIATION PROTECTION CENTRE

The Radiation Protection Centre (RPC), operating under the Ministry of Health, monitors foodstuffs, raw materials and drinking water. The RPC is responsible for setting and overseeing the norms for radioactive substances discharged into the environment; for issuing permits for such discharges from non-nuclear facilities (hospitals, laboratories, etc.); and for overseeing the monitoring of foodstuffs and drinking water. It is also responsible for the regulatory control of radiation protection and for a nationwide assessment of the exposure of the population, radiation workers and patients to different sources of ionising radiation, including communities' exposure from local food products, a mixed diet and drinking water. Where needed, the RPC draws up recommendations to optimise radiation protection measures.

4.3 NATIONAL FOOD AND VETERINARY RISK ASSESSMENT INSTITUTE

The National Food and Veterinary Risk Assessment Institute (NFVRAI), operating under the State Food and Veterinary Service, runs official radiological monitoring programmes on raw materials of animal origin. It also inspects imported products (consignments) from other countries contaminated after the Chernobyl accident – especially Ukraine, Belarus and some areas of Russia – and certifies goods for export.

4.4 STATE NUCLEAR POWER SAFETY INSPECTORATE

The State Nuclear Power Safety Inspectorate (VATESI) is responsible for setting and overseeing the norms for radioactive substances discharged into the environment and for issuing permits for such discharges from nuclear facilities.

5 RADIOACTIVITY MONITORING PROGRAMMES

5.1 INTRODUCTION

There are no operational nuclear power plants in Lithuania, but there are active nuclear decommissioning operations being carried out in the country (Ignalina NPP) and nuclear new-build projects in the neighbouring countries (Belarusian and Kaliningrad NPP projects). Therefore a strict monitoring regime should be maintained for environmental radioactivity, especially as regards the early warning network.

Surveillance of artificial radiation and artificial radionuclides is included in the monitoring of radioactivity in the environment and foodstuffs. Exposure to natural radiation is monitored using research activities where there is a suspicion that the public may have been exposed to unusually high levels of natural radionuclides (e.g. indoor radon and natural radionuclides in drinking water).

5.2 MONITORING OF EXTERNAL GAMMA DOSE

The RPC monitors ambient doses among the population. External gamma exposure is evaluated using thermoluminescent dosimeters (TLDs). Ambient dose equivalent measurements have been taken with TLDs in Vilnius, Kaunas, Šiauliai, Klaipėda and Panevėžys (10 monitoring points in each location) since 2005 and in the Ignalina nuclear power plant (NPP) region and Kupiškis district (16 monitoring points in each location) since 2000. The measurements are taken with two TLDs and four LiFl:Mg,Ti pellets at each monitoring point over a 6-month period. A RADOS TLD system is used to prime and read the TLDs. This system is calibrated annually according to internal procedure. TLDs used for calibration are irradiated at a secondary standard dosimetry laboratory (in 2015, the Czech Metrology Institute). The monitoring points and measurement results are shown in the figures below.

Figure 1. Average annual ambient dose equivalent (mSv) in Lithuania in 2015

Figure 2. Monitoring points and average annual ambient dose equivalent in Vilnius in 2015

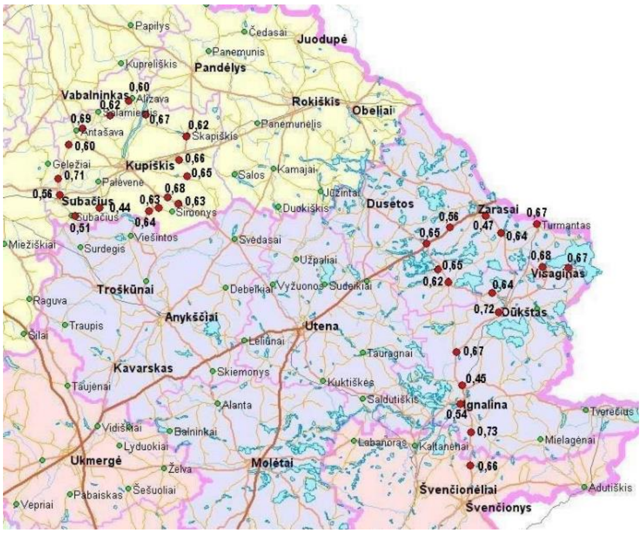


Figure 3. Monitoring points and ambient dose equivalent (mSv) in the Ignalina NPP region and Kupiškis district for 2015

5.3 MONITORING OF EXTERNAL GAMMA DOSE RATE

The EPA's Automatic Measurement Systems Division has the task of maintaining the network of automatic radiation monitoring stations. To do this, the division's RADIS team performs daily maintenance and checks on the network equipment, organises calibrations and repair work, and analyses and checks the primary data. Table I and Figures 4 and 5 below show detailed station characteristics, a map indicating station locations and a data transfer scheme.

Table I. RADIS station technical specifications

Station type	Number of stations	Measurement type	Measurement range	Equipment
SARA AGS 711F	16	Gamma dose rate, gamma spectrum, internal station temperature	1 nSv/h – 100 µSv/h (NaI scintillator) 50 µSv/h – 100 mSv/h (GM tube)	- 1.5" x 1.5" NaI(TI) scintillation detector - Geiger-Muller (GM) detector 70 017A
SARA water	3	Gamma dose rate, gamma spectrum, internal station temperature	Up to 80 µSv/h	- 3" x 3" Spectroscopic NaI (TI) detector

The alarm threshold for the gamma dose rate in Lithuania is set at 300 nSv/h. If this threshold is reached at any measuring station, an alarm notice is sent to a predefined list of staff at Lithuanian institutions. If a lower, 'internal/technical' threshold of 200 nSv/h is reached, an alarm notice is sent only to the division's RADIS team.

The Automated Environmental Monitoring System is linked to the Danish Emergency Management Agency database (the ARGOS network, for bilateral data exchange and cooperation). Measurements are taken over 10-minute periods and transferred to a central data collection system in Vilnius. Data are made public at http://radis.aplinka.lt/ within 20 minutes. All data are collected and electronically archived in SQL databases. Battery backup can support operations for three days without external power. In order to provide reliable measurement results, the division implements a QA/QC programme (see Table II below).

It is worth pointing out that the station network was modernised in recent years; old stations were replaced and five new stations were installed. Work to install more new stations is ongoing.

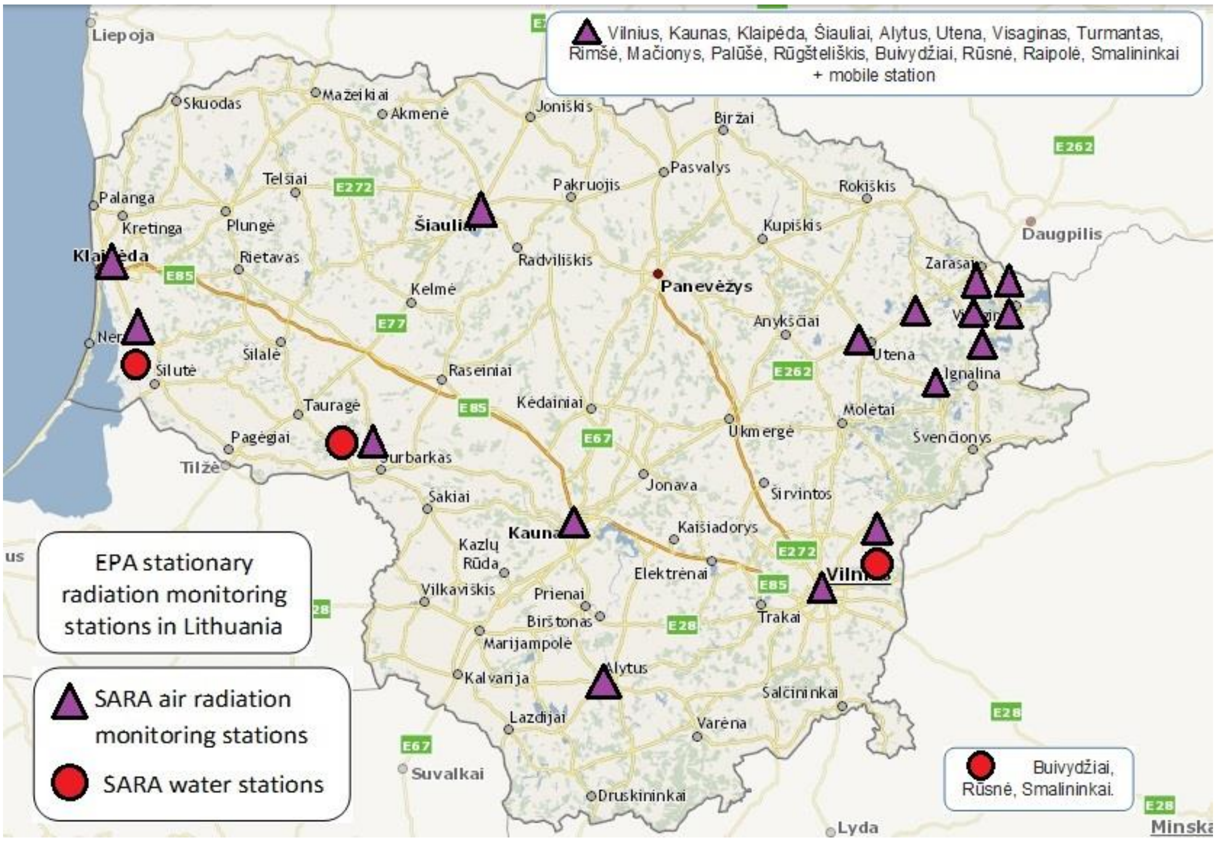


Figure 4. RADIS stations

Table II RADIS QA/QC programme

	Constant monitoring of measurement results	Technical maintenance and checks on equipment	Legal metrological equipment check	Calibration/ check	Repair
Geiger-Müller tube + NaI detector (SARA stations)	Every working day*	Every 3 months	Once a year	Once a year	When necessary
All other SARA and mobile station equipment (computers, power cables, data cables, fastening elements, multichannel analysers etc.)	–	Every 3 months	–	–	When necessary

*except mobile station

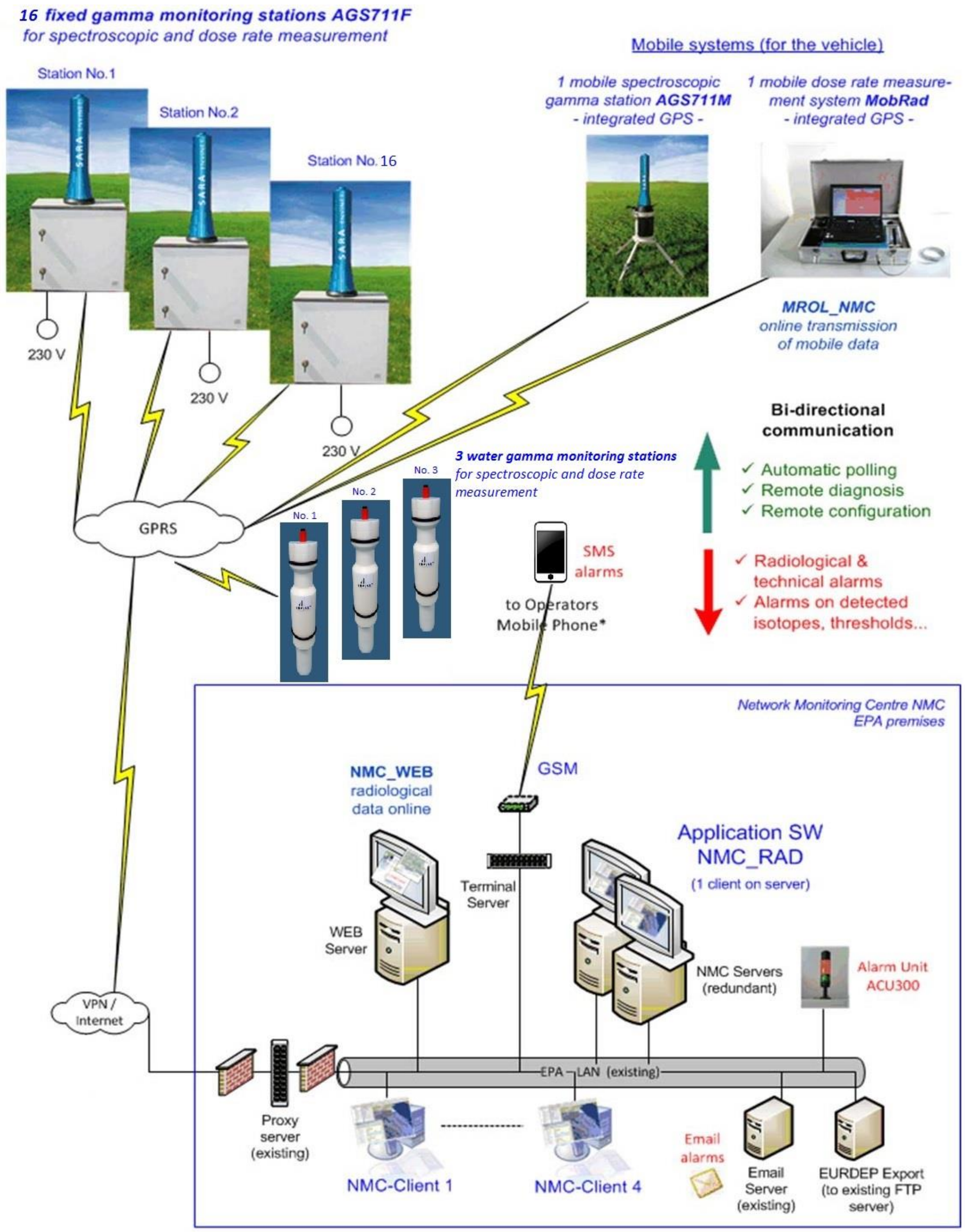


Figure 5. RADIS communication scheme

5.4 MONITORING OF RADIOACTIVITY CONCENTRATION IN AIR

5.4.1 Air samplers

An air monitoring programme is implemented by the EPA. Currently one offline and one online station collect particulate matter on fiberglass filters:

- A HUNTER medium-volume air sampler is situated in Utena, eastern Lithuania, 60 km from the Ignalina NPP. The sampler is 10 metres above ground level. Sampling is done by specialists from the Utena Regional Environment Protection Department, operating under the Ministry of Environment, and samples are sent to the EPA Radiology Division laboratory in Vilnius.
- An automated CANBERRA CUSAM station was installed in May 2013 in Vilnius, on the Radiology Division premises.

Additionally under the contract samples are collected in the vicinity NPP of by Centre for Physical Sciences and Technology.

Details on sampling and a map with the locations of the air sampling devices are shown in Tables III to V and Figure 7 below.

Table III. Non-automated air radioactivity concentration measurements (HUNTER)

Air/airborne particulates	Nuclide	Cs-137, Be-7, I-131, other γ emitters
	Number of sites	1
	Frequency	Every 3 to 4 days aerosol filters, if necessary it is done more frequently, Activated charcoal filters are used for I-131 measurements only if I-131 is detected in aerosols or information on accident is received.
	Sample details	Aerosols on fibreglass filters, I-131 on activated charcoal filters
	Sample preparation	Samples are pressed to tablet form and placed onto cylindrical holder P-35, diameter 45 mm, height 7 mm
	Detection method	Gamma spectrometry with HPGe extended range detector by CANBERRA, relative efficiency at 1.33 MeV — 34 %, FWHM at 1.33 MeV — 1.73 keV. GENIE 2000 software by CANBERRA is used to evaluate results. Efficiency calibration uses the Monte Carlo method, with Labsocs software. The detector is fully characterised, with characterisation verified by the producer
	Reporting unit	Bq/m^3
	Detection limit	About 2-4 $\mu Bq/m^3$ for Cs-137
	Sample size	8 000 - 17 000 m^3

Table IV. Non-automated air radioactivity concentration measurements (Centre for Physical Sciences and Technology (FTMC)

Air/airborne particulates	Nuclide	Cs-137, Be-7, Pb-210, other γ emitters
	Number of sites	1
	Frequency	Every 2 weeks
	Sample details	Aerosols on FPP-15- (Petrianov-) type filters
	Sample preparation	Samples are put in 500 cm^3 Marinelli beakers to respect the standard geometric conditions for which the calibration standard is used
	Detection method	Gamma-ray spectrometry with HPGe coaxial detector (relative efficiency at 1.33 MeV — 30 %; FWHM at 1.33 MeV – 1.72 keV) and a well-type detector (relative efficiency at 1.33 MeV – 38 %; FWHM at 1.33 MeV – 2.05 keV). GammaVision-32 software by EG&G ORTEC is used to evaluate results.
	Reporting unit	$\mu Bq/m^3$
	Detection limit	About 1.5 $\mu Bq/m^3$ for Cs-137
	Sample size	≅ 300 000 m^3

Table V. Automated air radioactivity concentration measurements (CUSAM)

Air/airborne particulates	Nuclide	Total alpha artificial, total alpha natural, total beta artificial, Cs-137, Be-7, I-131, other γ emitters
	Number of sites	1
	Frequency	Every 4-6 hours, if necessary it can be done more frequently
	Sample details	Aerosols on fiberglass filters
	Sample preparation	No preparation, measurements are done directly
	Detection method	Alpha/beta – CAM PIPS detector. Gamma spectrometry with HPGe extended range detector by CANBERRA, relative efficiency at 1.33 MeV — 27.6 %, FWHM at 1.33 MeV — 1.75 keV. Special software and GENIE 2000 by CANBERRA are used to take measurements and evaluate results.
	Reporting unit	Bq/m^3
	Detection limit	0.005 Bq/m^3 (Co-60) for a complete day. 0.03 Bq/m^3 for a 4-hour measurement. The detection limits for the alpha and beta activities are 0.01 and 0.03 Bq/m^3 respectively
	Sample size	30 - 60 m^3

5.4.2 Dry/wet deposition collectors

Deposition (dry and wet) is collected at five locations (Vilnius, Kaunas, Klaipeda, Utena and Dukstas). Samples are taken by staff at the meteorological stations (the Hydrometeorology Service, operating under the Ministry of the Environment) and sent by mail to the laboratory. A map with the locations of the collectors and details of sampling and measurement are shown in Table VI and Figure 6 below.

In addition, the RPC operates a simple dry-wet deposition collector, installed on its premises in Vilnius. Located on the roof of the technical section of the building, it has a surface area of 0.049 m^2. Wet depositions are in a 20-litre canister inside the building. Sampling is performed monthly. Wet depositions are transported to the laboratory for evaporation and ashing of residue. Deposition samples are measured for gross alpha and gross beta; integrated (quarterly) samples are monitored by gamma spectrometry and for Sr-90.

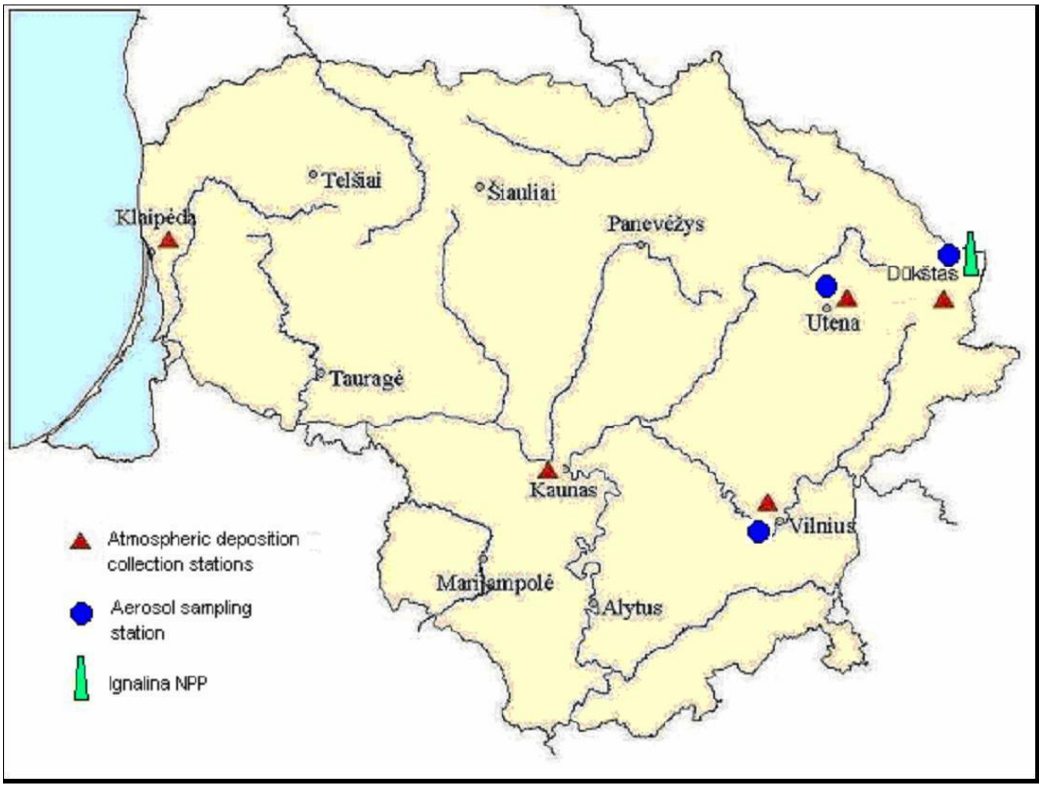


Figure 6. Dry/wet deposition collectors and air samplers

Table VI. Monitoring of dry/wet deposition

Deposition	Nuclide	Gross β
	Number of sites	5
	Frequency	Every 5 days
	Sample details	Wet and dry deposition on textile filters
	Sample preparation	Treatment of samples is done by burning for 5 hours at 450°C
	Detection method	Measurements are performed on a Thermo Scientific FHT 770T multi-low-level counter. Special software is used to evaluate results. Efficiency calibration using samples prepared with a standard solution is available
	Reporting unit	Bq/m^2 per day
	Sample collection area	0.3-0.4 m^2

5.5 MONITORING OF RADIOACTIVITY CONCENTRATION IN WATER

5.5.1 Introduction

Radioactivity concentration in water is monitored by manually taking water samples at regular intervals and analysing them in a laboratory. There are no automated water sampling systems for radiological monitoring in Lithuania.

5.5.2 Surface water

The EPA is responsible for determining the activities of radionuclides in surface water from lakes and rivers. Sampling is performed by its Expedition Measurements Division (part of the Environmental Research Department), its Marine Research Department or the regional environmental protection departments operating under the Ministry of the Environment. The sampling sites and description of procedures are presented in Figure 7 and Table VII below.

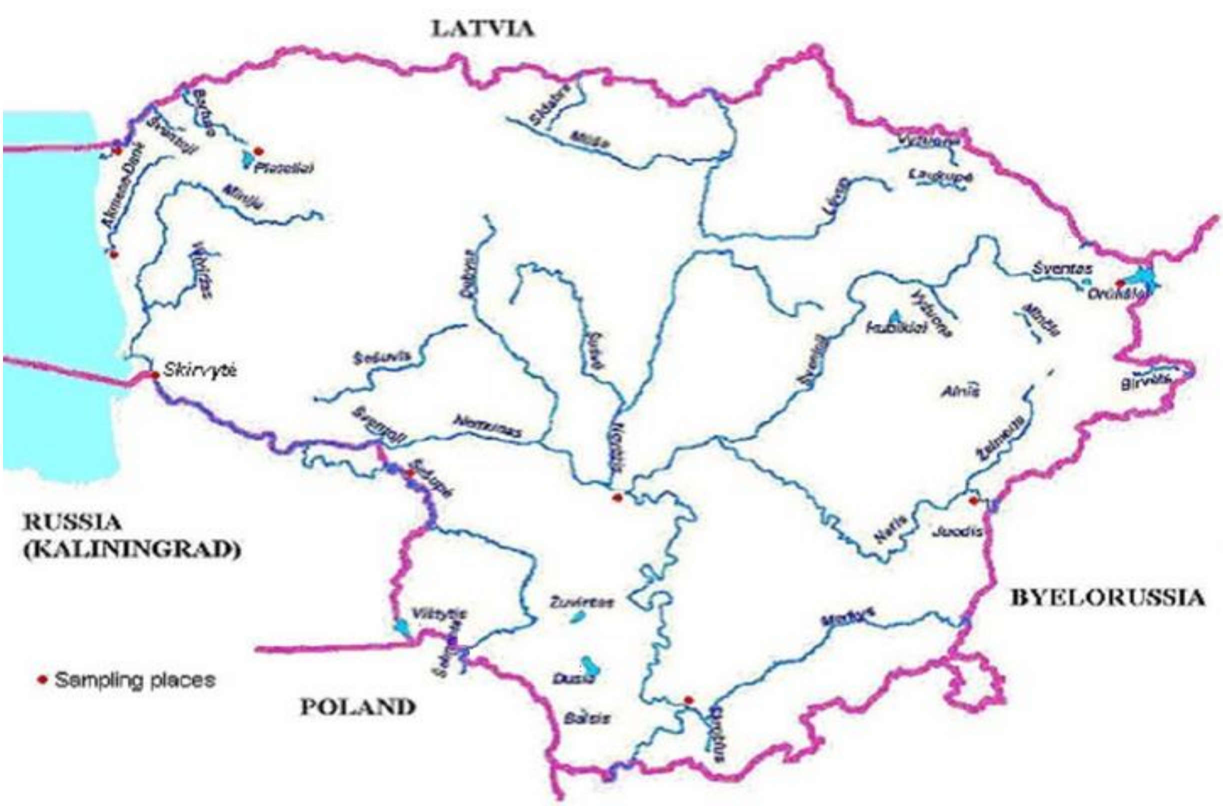


Figure 7. Surface water sampling sites (3 in lakes, 6 in rivers)

Table VII. Monitoring of surface water

Surface water (freshwater)	Nuclide	Cs-137, Cs-134, Co-60, Sr-90
	Number of sites	9 (3 in lakes, 6 in rivers)
	Frequency	4 times a year in rivers, 2 to 6 times a year in lakes
	Sample details	Samples from rivers and lakes
	Sample preparation	Evaporation of 10 l sample for gamma spectrometry. Concentration of Sr-90 from 20 l of water with HCl, NH_4OH, $Sr(NO_3)_2$, Na_2CO_3. Extraction of Y-90 (with 10 % HDEHP solution) in n-heptane toluene from dissolved sample. After purification, yttrium is re-extracted with hydrochloric acid. After washing, yttrium is precipitated as hydroxide and finally as oxalate. Y chemical yield is determined by weighing.
	Detection method	Gamma spectrometry by CANBERRA (same as for non-automated aerosol measurements) or with ORTEC GEM 40P4- 76 HPGe coaxial detector (relative efficiency at 1.33 MeV — 40 %, FWHM at 1.33 MeV —

		1.85 keV). ORTEC GammaVision software is used to take measurements and evaluate results. Efficiency calibration uses standard sources. Measurements of Sr-90 are performed on an FHT 770T multi-low-level counter (as for total beta measurements)
	Reporting unit	Bq/m^3
	Detection limit	About 2 Bq/m^3 (Sr-90), 1-5 Bq/m^3 (Cs-137)
	Sample size	10 l (for gamma) or 20 l (for Sr-90)

5.5.3 Ground water and drinking water

Lithuania has transposed Council Directive 2013/51/Euratom of 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. Routine monitoring of drinking water follows the requirements set out in Lithuanian Hygiene Standard HN 24:2003, 'Safety and quality requirements for drinking water', approved by the minister for health. This standard also lays down the restrictions to be imposed in response to radioactivity in water. At least 2000 water supply entities are responsible for monitoring activity (the frequency of which depends on the volume of drinking water produced or supplied). In case of an emergency, this activity can help to detect radioactive substances in drinking water and to implement measures to restrict the usage of contaminated drinking water.

The RPC is responsible for the radiological monitoring of drinking water in Lithuania. The monitoring network has dense areas (in which sampling is done quarterly) and sparse areas (in which it is done monthly). The dense areas network includes periodic sampling at seven sampling sites: three in the Ignalina NPP region (the Ignalina, Zarasai and Utena districts), together with Kaunas, Klaipėda, Panevėžys and Šiauliai. In the Vilnius region drinking water samples are taken monthly (as part of the sparse areas network). There are four sampling points per sampling site — three from private wells and one from the local water supply.

Table VII. Monitoring of ground water and drinking water

Drinking water/ground water	Nuclide	H-3, gross α, gross β (excluding tritium, potassium-40 and radon with its daughters)
	Number of sites	8 (with 4 sampling points at each location)
	Frequency	4 times a year (monthly at one site)
	Sample details	Drinking water from private wells and local water supply
	Detection method	Proportional counter for gross α and β, liquid scintillation counter for H-3
	Reporting unit	Bq/litre
	Detection limit	0.001 (gross α), 0.01 (gross β), < 5 (H-3) Bq
	Sample size	2 litres

5.5.4 Sea water

The EPA is responsible for marine environment monitoring. Its Marine Research Department takes the samples, which are prepared and measured at the Radiology Division laboratory. A map and a description of procedures are shown below.

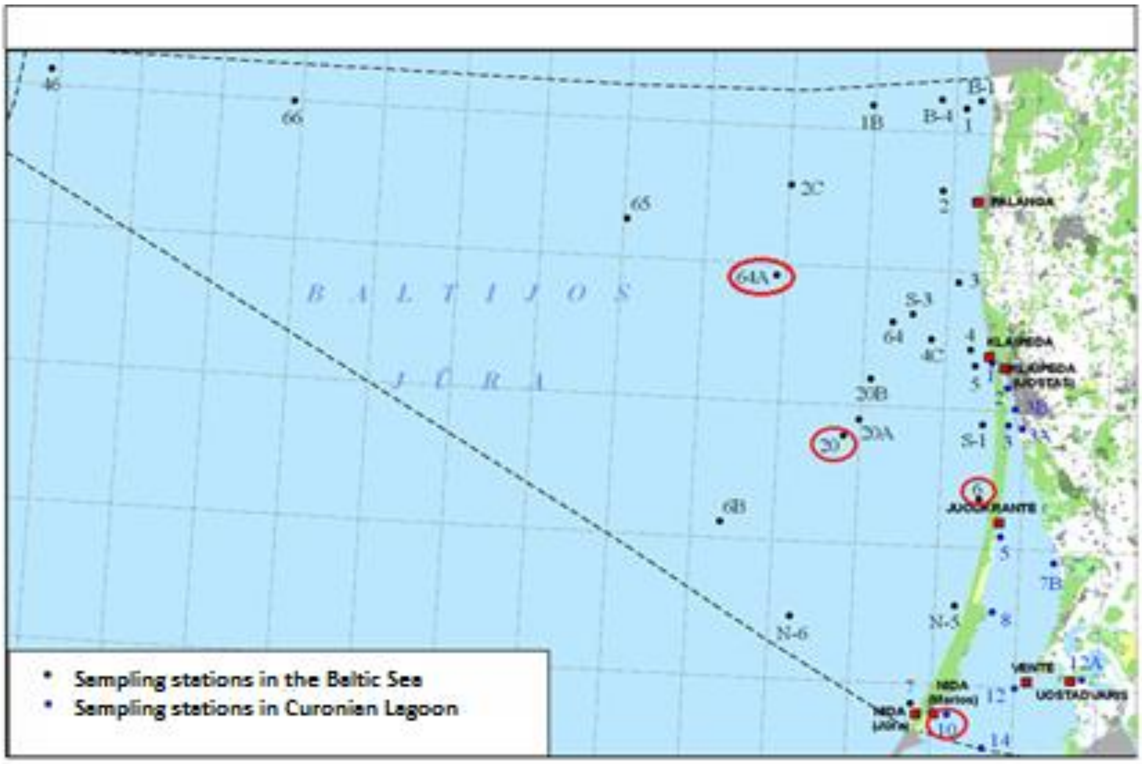


Figure 8. Seawater sampling sites

Table IX. Monitoring of sea water

Sea water	Nuclide	Cs-137, Sr-90
	Number of sites	4
	Frequency	1 to 4 times a year, depends on the station
	Sample preparation	Same as for surface water samples.
	Sample details	Surface water
	Detection method	Gamma spectrometer, proportional counters for Sr-90. Same as described for air measurements.
	Reporting unit	Bq/m^3
	Detection limit	About 2 Bq/m^3 (Sr-90), 1-5 Bq/m^3 (Cs-137)
	Sample size	10 l (for gamma) or 20 l (for Sr-90)

5.6 MONITORING OF RADIOACTIVITY CONCENTRATION IN SEDIMENTS

Radioactivity concentration in sediments is monitored by manually taking samples at regular intervals and analysing them in a laboratory. The EPA is responsible for determining radionuclide activity in bottom sediments from lakes and rivers. Sampling is performed by its Expedition Measurements Division (part of the Environmental Research Department), its Marine Research Department or the regional environment protection departments operating under the Ministry of the Environment. The sampling sites are the same as those for water.

Table X. Monitoring of sediments

Freshwater sediments	Nuclide	γ, Sr-90
	Number of sites	9 (3 in lakes, 6 in rivers)
	Frequency	Twice a year in rivers, 1 to 4 times a year in lakes, depends on the station
	Sample preparation	For gamma measurements: drying in the room and after in the oven (at 105^{o}C), homogenisation. Measured using 0.5 l Marinelli or smaller cylindrical geometry. For Sr-90: Drying, homogenising and ashing at 610^{o}C; extraction of Y-90 (with 10 % HDEHP solution) in n-heptane toluene from dissolved ash sample. After purification, yttrium is re-extracted with hydrochloric acid. After washing, yttrium is precipitated as hydroxide and finally as oxalate. Y chemical yield is determined by weighing.
	Sample details	Sediments from lakes (deepest place) and rivers, surface layer
	Detection method	Gamma spectrometer, proportional counter for Sr-90. Same as described for air measurements
	Reporting unit	Bq/kg dry weight
	Detection limit	About 1 Bq/kg
	Sample size	100-600 g dry weight
Marine sediments	Nuclide	γ, Sr-90
	Number of sites	4
	Frequency	1 to 3 times a year, depends on the station
	Sample preparation	For gamma measurements: drying in the oven (105-110^{o}C), homogenisation. Measured using Marinelli geometry. For Sr-90: Drying, homogenising and ashing at 610^{o}C; extraction of Y-90 (with 10 % HDEHP solution) in n-heptane toluene from dissolved ash sample. After purification, yttrium is re-extracted with hydrochloric acid. After washing, yttrium is precipitated as hydroxide and finally as oxalate. Y chemical yield is determined by weighing.
	Sample details	Grab sample, layer of 0 to 20 cm
	Detection method	Gamma spectrometer, proportional counter for Sr-90. Same as described for air measurements.

	Reporting unit	Bq/kg dry weight
	Detection limit	About 1 Bq/kg
	Sample size	100-600 g dry weight

5.7 MONITORING OF TERRESTRIAL AND AQUATIC BIOTA

The EPA determines radionuclide activity in biota from Lake Drūkšiai and the Baltic Sea. Sampling is performed by the Utena Regional Environment Protection Department operating under the Ministry of the Environment and the Marine Research Department (EPA) respectively.

Monitoring of biota was included in the National Environmental Monitoring Programme in 2011; before that some aquatic biota measurements were performed in the Baltic Sea in accordance with HELCOM recommendations and in Lake Drūkšiai as part of the monitoring activities at the Ignalina NPP.

Table XI. Monitoring of aquatic biota

Freshwater biota	**Nuclide**	γ, Sr-90
	Number of sites	1
	Frequency	Once a year
	Sample preparation	For gamma measurements: drying at room temperature, homogenisation. Measured using Marinelli geometry. For Sr-90: Drying, homogenising and ashing at 610^{o}C; extraction of Y-90 (with 10 % HDEHP solution) in n-heptane toluene from dissolved ash sample. After purification, yttrium is re-extracted with hydrochloric acid. After washing, yttrium is precipitated as hydroxide and finally as oxalate. Y chemical yield is determined by weighing.
	Sample details	Aquatic plants
	Detection method	Gamma spectrometry, proportional counter
	Reporting unit	Bq/kg dry weight
	Detection limit	1 Bq/kg
	Sample size	100-200 g dry weight
Marine biota	Nuclides	γ, Sr-90
	Number of sites	1 or 2 (in stations 2 and 20 on the map), fish sampling is done across wider areas near these stations
	Frequency	Once per year
	Sample preparation	For gamma measurements: plants — drying in room temperature, homogenisation fish — cutting, blending, mixing Measured using Marinelli geometry; For Sr-90: Drying, homogenising and ashing at 610^{o}C; extraction of Y-90 (with 10 % HDEHP solution) in n-heptane toluene from dissolved ash sample. After purification, yttrium is re-extracted with hydrochloric acid. After washing, yttrium is

		precipitated as hydroxide and finally as oxalate. Y chemical yield is determined by weighing.
	Sample details	Aquatic plants, if possible fish
	Detection method	Gamma spectrometry, proportional counter
	Reporting unit	Bq/kg dry weight for plants, Bq/kg fresh weight for fish
	Detection limit	1 Bq/kg
	Sample size	100-200 g dry weight for plants 500-700 g wet weight for fish

5.8 MONITORING OF RADIOACTIVITY CONCENTRATION IN FOOD AND FEED

5.8.1 Introduction

The RPC takes samples of drinking water and foodstuffs (and fallout) under the national radiological monitoring programme at the sampling points indicated in Figure 9 below.

Figure 9. Drinking water and foodstuffs sampling points (blue — drinking water, grey — milk, red — meat, orange — fish, yellow — potatoes, brown — cereals, green — cabbages, purple — mixed diet, black — fallout)

5.8.2 Milk

Radioactivity concentration in milk is monitored by manually taking milk samples at regular intervals and analysing them in a laboratory. The RPC is responsible for milk sampling and radiological investigation.

Table XII. Monitoring of milk

Milk	Nuclide	Gross α, gross β, Sr-90, gamma spectrometry (Cs-137, K-40)
	Number of sites	8
	Frequency	4 times a year (monthly in Vilnius)
	Sample details	Fresh milk collected from private farms or regional dairies and markets, only local production
	Detection method	Proportional counter (gross α and β), LSC (Sr-90), gamma spectrometry (Cs-137, K-40)
	Reporting unit	Bq/kg
	Detection limit	0.001 (gross α), 0.01 (gross β, Cs-137, Sr-90), 0.2 (K-40)
	Sample size	4 l

5.8.3 Mixed diet

Radioactivity concentration in a mixed diet is monitored by manually taking samples of the food ingested by one person on one day at regular intervals and analysing them in a laboratory. The RPC is responsible for mixed diet sampling and radiological investigation.

Table XIII. Monitoring of mixed diet

Complete meals/average diet	Nuclide	Gross α, gross β, Sr-90, gamma spectrometry (Cs-137, K-40)
	Number of sites	1
	Frequency	Monthly
	Sample details	Mixed 24-hour diet
	Detection method	Proportional counter (gross α and β), liquid scintillation (Sr-90), gamma spectrometry (Cs-137, K-40)
	Reporting unit	Bq/kg
	Detection limit	0.001 (gross α), 0.01 (gross β, Cs-137, Sr-90), 0.2 (K-40)
	Sample size	24-hour food intake

5.8.4 Other foodstuffs

Radioactivity concentration in other foodstuffs is monitored by manually taking samples of various foodstuffs and analysing them in a laboratory. The RPC is responsible for the sampling and radiological investigation of raw local foodstuffs and food products (meat, fish, grain, cabbages and potatoes).

Table XIV. Monitoring of foodstuffs

Other sundry food products	Nuclide	Gross α, gross β, Sr-90, gamma spectrometry (Cs-137, K-40)
	Number of sites	7
	Frequency	Twice a year for meat and fish, once a year for vegetables and grain
	Sample details	Fresh food: meat, fish, vegetables (potatoes, cabbage), grain, mushrooms. Non-edible parts removed.
	Detection method	Proportional counter (gross α and β), liquid scintillation (Sr-90), gamma spectrometry (Cs-137, K-40)
	Reporting unit	Bq/kg
	Detection limit	0.001 (gross α), 0.01 (gross β, Cs-137, Sr-90), 0.2 (K-40)
	Sample size	3 kg for meat; 4 kg for fish (or fish fillets), vegetables and grain

5.8.5 Feedstuffs

Radioactivity concentration in feedstuffs is monitored by manually taking samples of different feedstuffs and analysing them in a laboratory. The NFVRAI is responsible for monitoring raw foodstuffs and feedstuffs. Samples are delivered by veterinary inspectors from the State Food and Veterinary Service.

Table XV. Monitoring of feedstuffs

Raw foodstuffs and feedstuffs	Nuclide	Cs-137, Sr-90
	Number of sites	Defined every year by the order of Director of the State Food and Veterinary Service
	Frequency	
	Sample preparation	For gamma measurements: mixing. For Sr-90: primary desiccation, burning in a heating oven, emission of radionuclides and transfer of a sample into measuring dishes
	Sample details	Poultry, beef, pork, milk, fish, eggs, wild game, etc.
	Detection method	Gamma spectrometry with a GEM 50P4 semiconductor detector by ORTEC, and DSPEC jr 2.0 digital analyser. Counting time 43 200 sec. Analysis using GAMMA VISION 6.01 software. Efficiency calibration uses certified multi-isotope standards (energy range 60-1820 keV). Sr-90 samples are measured using the BECMAN LS 6500 multipurpose scintillation counter. Counting time is 100 minutes. Efficiency calibration uses a certified single isotope standard.
	Reporting unit	Bq/kg

In addition to the NFVRAI measurements, the RPC has been running a sampling and measuring programme for mushrooms every year since 1998. Edible mushrooms are sampled at different locations during the summer and autumn seasons (with approximately 100 samples taken per year). Gamma spectrometry measurements are performed in 0.5 litre volumes for Cs-137.

5.9 MOBILE MEASUREMENT SYSTEMS

5.9.1 Environmental Protection Agency

The Environmental Protection Agency has two mobile monitoring systems:

- A mobile SARA station: similar to the other 16 air radiation monitoring stations but portable; it can be transported to any location in Lithuania.
- A mobile monitoring system (MobRad), carried in portable luggage. The system is equipped with an integrated, sensitive HGD 101 handheld dose rate meter, an integrated GPS receiver with magnetic antenna, a laptop-based system (with carrying case) and software for data communication, storage and visualisation. MobRad can record the environmental gamma dose rate from a moving vehicle.

Table XVI. EPA mobile monitoring equipment

Station type	Number of stations	Measurements type	Measurement range	Equipment
Mobile (MobRad)	1	Gamma dose rate, geographical coordinates	0.05 µSv/h – 10 Sv/h	- Integrated, highly sensitive HGD 101 handheld dose rate meter - Integrated GPS receiver with magnetic antenna - Laptop-based system (with carrying case) - MS-ACCESS database - MobRad software for data communication, storage and visualisation
Mobile (SARA AGS 70M)	1	Gamma dose rate, spectrum, geographical coordinates	1 nSv/h – 100 µSv/h	- Data communication via mobile cellular networks (GPRS) - four-legged stand (fold-out & adjustable) - 1.5’ x 1.5’ Na (TI) scintillation detector and Geiger-Muller (GM) detector - GPRS integrated receiver

5.9.2 Radiation Protection Centre

The RPC has a mobile laboratory housed in a Mercedes-Benz vehicle. It is equipped with:

- an energy supply, air conditioning and filtering systems;
- space for two workstations;

- equipment (manufactured by Berthold) to measure radionuclide activity (counting of beta/gamma activity concentration and radioactive iodine in air);
- a dose rate measurement device that can take measurements using a GPS link to a PC;
- a gamma spectrometer (HPGe crystal, diameter 63.5 mm, length 64.4 mm, relative efficiency 51.1 %, GENIE 2000 for analysis, detector with collimator, and spectrometer on a tripod holder). The spectrometer cannot be used during travel.

The RPC has a MONA mobile spectroscopic detection and survey system for vehicle or airborne use, produced by ENVINET. It is able to detect small amounts of artificial radiation in the environment, coming from potential threats such as nuclear incidents or accidents. MONA can be used by mobile emergency response teams to detect and locate radiation and contamination in the environment. The system acquires the gamma spectra, identifies the isotopes and calculates the total gamma dose rate. The complete data set is stored in a local database: data are displayed on a mobile PC in the vehicle as colour-coded tracks on a map, and linked to spectra, waterfall diagrams, graphs and tables. MONA can be extended to include two 4-litre scintillator detectors. The detection unit can be either installed outside the vehicle (typically on the roof of the car) or inside it. No wired connection is needed between the detection units and the PC. The detection unit can be powered from its integrated rechargeable battery for approximately 24 hours.

5.10 THEMATIC INVESTIGATIONS

5.10.1 Visaginas soil baseline investigation, 2011-14

From 2011 to 2014, the RPC performed radiological investigations of soil in the vicinity of planned NPPs and NPPs under construction (Visaginas, Belarusian and the Baltic NPP). These data can be used in the future to assess these plants' potential impact on the Lithuanian population in terms of exposure.

Sampling points were chosen in areas of 10 km x 10 km on Lithuanian territory approximately 50 km from the sites of the new NPPs. At each sampling point three soil samples were taken in undisturbed places, up to 30 cm in depth. This gave 18 sub-samples of 5 cm in depth for investigation. Counting used gamma spectrometry. Figure 10 shows the sampling points and the sampling methodology.

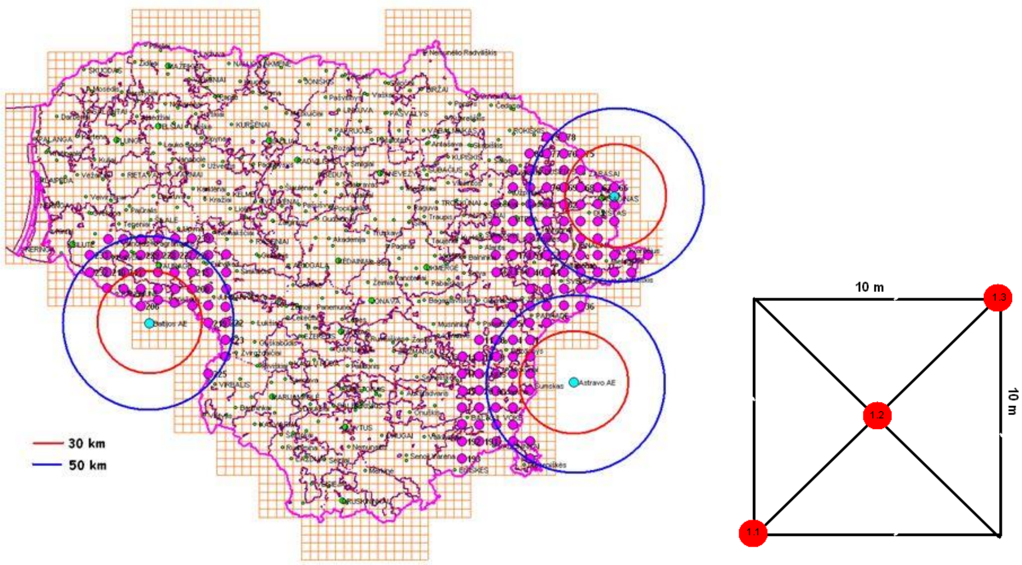


Figure 10. Soil sampling map and methodology at each sampling point

5.10.2 Cs-137 in wood, 2015

In 2015, the RPC analysed Cs-137 in wood samples from the region located close to the border with Belarus and to the site where the Belarusian NPP is being constructed. Wood samples were collected in the Poškonys district (Stakai forest, Bukiškio forest) and the Barkov forest near the Dieveniškės district. Cs-137 activity concentrations varied from 2 to 6 Bq/kg.

5.11 INFORMATION FOR THE GENERAL PUBLIC

5.11.1 Radiation Protection Centre

The RPC posts annual reports on its website[8]. Its annual work report, along with the annual monitoring reports on public exposure, on food and drinking water and on external radiation has been available to the public since 2004. The annual report on public exposure monitoring typically looks at exposure from different sources: food, drinking water, game, soil, air, surface water, radionuclide discharges into the environment, external doses from soil and cosmic radiation, doses from indoor radon, medical exposure for patients, etc.

5.11.2 Environment Protection Agency

The EPA publishes data from the environmental radiological monitoring programme on its website[9], together with reports from the FTMC[10]. Data from the network of automatic radiation monitoring stations are also available online [11] and, along with data from the automated aerosol station, are sent to the Commission's EURDEP database; they are also accessible from the EURDEP website.

6 LABORATORIES PARTICIPATING IN THE NATIONAL ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAMME

6.1 EPA – RADIOLOGY DIVISION OF THE ENVIRONMENTAL RESEARCH DEPARTMENT

The EPA radiology laboratory monitors radioactivity in air aerosols, deposition and surface water (water, bottom sediments and biota). For a description of laboratory procedures and equipment, see Appendix 2B.

6.2 RPC – DEPARTMENT OF EXPERTISE AND EXPOSURE MONITORING

The RPC laboratory monitors foodstuffs, raw foodstuffs, mixed diet components and drinking water. In addition, it maintains capabilities for mobile emergency monitoring. For a description of laboratory procedures and equipment, see Appendix 3B.

6.3 NFVRAI – RADIOLOGY GROUP, CHEMISTRY UNIT

The NFVRAI laboratory runs radiological monitoring programmes on raw materials of animal origin, inspects imported products from other countries and certifies goods for export. For a description of laboratory procedures and equipment, see Appendix 4B.

8 www.rsc.lt.

9 http://gamta.lt.

10 http://oras.gamta.lt.

11 http://radis.aplinka.lt.

7 VERIFICATIONS

7.1 FOLLOW-UP TO THE 2011 RECOMMENDATIONS

Verification activities were carried out in accordance with the agreed programme. The verification team reviewed the recommendations issued in 2011[12]. Table XVII below summarises the recommendations and their follow-up.

Table XVII. Follow-up to the 2011 recommendations

Recommendation 2011	**Follow-up 2016**
The verification team recommends full modernisation of the automatic radiation dose rate monitoring network and increasing the number of high-volume air sampling systems.	**Completed**. The old network has been decommissioned and replaced with the new RADIS network. A new air sampling system has been installed in Vilnius.
The verification team suggests the EPA improve the availability of official information on environmental radiation in the public domain.	**Completed**. Dose rate and Vilnius air concentration readings are available online. Annually repots with environmental monitoring results are placed in a website.
The verification team recommends the EPA laboratory to consider adding regular controls of peak width and energy stability in the HPGe-detector control programme.	**Completed**. Stability and resolution controls have been included in the EPA laboratory control procedures.
The verification team recommends the NFVRAI laboratory to consider adding regular controls of peak width stability (FWHM) in the HPGe-detector control programme.	**Completed**. Stability and resolution controls have been included in the NFVRAI laboratory control procedures.
The verification team recommends that the maintenance procedures of the monitoring stations be reviewed and arrangements made for continuous maintenance of the stations.	**Partially completed**. The new network requires less maintenance than the old PMS stations. The EPA has one staff member trained for continuous maintenance of the stations, which may not be sufficient in all situations.
The verification team recommends reviewing the functionality and safety of physical access to each automatic station.	**Completed**. The old PMS stations have been decommissioned; there is safe access to all new stations.
The verification team recommends that the EPA reviews the operational status of the AGIR network stations and takes appropriate action to either repair the stations or decommission the network.	**Completed**. The old AGIR stations have been decommissioned.

[12] Verifications under Article 35 of the Euratom Treaty, Technical report LT-11/05, 2011

The verification team recommends complete modernisation of the automatic radiation dose rate monitoring network data centre, including communication systems, alerting system and back-up power supply.	**Partially completed**. The old data centre has been replaced with a new one. A few improvements are still needed to guarantee a stand-by emergency service and power back-up (see section 7.2.1).

7.2 MONITORING OF AMBIENT GAMMA DOSE RATE

7.2.1 General

The verification team looked at the general layout of the RADIS automatic early warning network. This new, state-of-the-art network currently consists of 16 fixed (15 air and one water) monitoring stations and one mobile (Envinet SARA AGS 711) station. With a new nuclear power plant under construction in Astravyets, Belarus, work is under way to install another fourteen dose rate stations on the border with Belarus. In addition, if work on the Russian nuclear power plant project in Kaliningrad were to continue, the EPA would be prepared to expand the network at the Lithuania-Kaliningrad border as well.

The verification team was informed that, although the radiation dose rate alerts are transmitted to EPA staff, there is no round-the-clock on-call service for radiological emergencies in Lithuania.

The new network requires less maintenance than the old PMS stations. Only one EPA staff member is trained to carry out routine network maintenance. This is insufficient to ensure that maintenance functions are always available.

> *The verification team recommends that the EPA organise a continuous emergency on-call service capable of responding to a possible radiological emergency within an hour of the first alert.*
>
> *The team further recommends increasing the number of trained staff for network maintenance.*
>
> *The team supports the planned installation of new stations close to the Belarus border.*

7.2.2 Vilnius

The verification team inspected the Envinet SARA station installed on the roof of the EPA building in Vilnius, some 40 metres above ground level.

> *No remarks.*

7.2.3 Buivydžiai

The verification team inspected the Envinet SARA station installed on the roof of the Buivydžiai water monitoring facility, some four metres above ground level. The detector is obscured by the overhanging trees.

> *The verification team suggests removing the trees in the vicinity of the station.*

7.2.4 RADIS monitoring network data centre

The RADIS system data centre is located at the EPA building in Vilnius. It is staffed by two experts, meaning that it cannot be manned round the clock. It receives dose rate data and a NaI gamma spectrum from each RADIS station, so is able to monitor dose rates and carry out low-resolution nuclide identification. In addition, it receives meteorological data from all stations. Alarms are transmitted to the EPA staff by SMS and email (alert levels 200 and 300 nSv/h). During routine operations data are polled every 30 minutes; in case of communication failures each station has a 24-hour data buffer memory.

For network maintenance purposes EPA staff have Cs-137 test sources, which are regularly installed at each monitoring station to check station response and stability (not an actual calibration of the dose rate measurement). For these tests the network software includes an automatic test procedure.

As part of the emergency preparedness arrangements, the data centre staff use the ARGOS decision support system for atmospheric dispersion simulations based on meteorological data received from Denmark. These simulations can be used to assess the dispersion of radioactive material from the nuclear power stations in countries neighbouring Lithuania.

Data centre PCs are equipped with UPS devices, which provide 2 to 3 hours of autonomy in the event of a power cut.

The verification team noted that in the activity report presented to the team the SARA stations provide the activity concentration values in Bq/cm^2, although Bq/m^3 would appear to be more logical. EPA staff were not aware of the meaning of the unit.

The verification team recommends that the EPA clarifies the significance of the unit Bq/cm^2 used in the activity reporting.

7.3 MONITORING OF RADIOACTIVITY CONCENTRATION IN AIR

7.3.1 Vilnius

The verification team inspected operations at the CANBERRA CUSAM medium volume air sampling system at the EPA laboratory in Vilnius. In operation since 2013, the system includes an electrically cooled HPGe gamma detector and an alpha/beta counter, which measure radioactivity on a rolling air filter paper. Air radioactivity concentration data produced by the system are exchanged via the EURDEP system. An air sample is taken from the laboratory roof; the sampling pipe is heated to avoid icing. The system is equipped with a UPS for the PC, analysers and cooler, but not for the air pump[13]. The system has internal control sources for quality assurance.

No remarks.

7.4 MONITORING OF RADIOACTIVITY CONCENTRATION IN SURFACE WATER

7.4.1 Buivydžiai

The verification team inspected operations at the SARA WATER automatic water radioactivity measurement station at the Buivydžiai water monitoring facility, some 64 km upstream from Vilnius and some 37 km downstream from the Belarusian NPP site. The station consists of a submerged detector and an electronics unit. It is part of the RADIS automatic network.

The team notes that the monitoring sensitivity of a submerged water detector is fairly low – water sampling and laboratory analysis are needed to improve it.

No recommendations. However, the verification team suggests that the EPA consider installing an automatic continuous river water sampling system in Buivydžiai when the Belarusian NPP becomes operational.

7.5 ANALYTICAL LABORATORIES

7.5.1 EPA laboratory

The verification team inspected operations at the EPA radiological laboratory. The laboratory monitors radioactivity in air aerosols, deposition and surface water (water, bottom sediments and biota). The facility was refurbished and checked by the Commission in 2011. It holds ISO/IEC

[13] The verification team was informed that a more powerful UPS will be installed in 2017 to provide electrical back-up for the air pump as well.

17025:2005 accreditation for gamma spectroscopy on surface water, biota, soil and bottom sediments and has a general ISO 9001 quality system.

A database (AIVIKS) has been developed for the Ministry of Environment for all environmental data measured by the authority, including radiological data, reported by economic entities. The system was demonstrated to the verification team.

The EPA laboratory is equipped with all necessary equipment for sample receipt, storage and preparation. It functions as a measurement laboratory; it does not analyse the measurement results, however makes evaluation of biota exposure. The laboratory currently has four people, three of them trained for gamma spectroscopy and three for beta counting. Radiological counting equipment includes two gamma spectroscopy systems and a low-level beta counter, as described in Appendix 2A.

In all, some 500 samples are analysed at the EPA laboratory every year. Most – about 360 – are cloths from the atmospheric deposition collectors. Others are air filter papers, water, sediments and biota.

> *Verification team notes that the laboratory staff, while sufficient for routine programme, would not be adequate to handle a large number of additional samples in the event of an emergency. The team recommends a review of resources and staff allocations to address the monitoring needs in an emergency situation.*

7.5.2 NFVRAI laboratory

The verification team visited the NFVRAI radiological laboratory, which carries out measurements on samples of animal origin under an annual programme drawn up by the Director of the State Food and Veterinary Service. The laboratory also inspects imported products (mainly mushrooms) from other countries, certifies goods for export and, as a commercial operation, measures drinking water samples. The samples are collected by veterinary inspectors from various regions and counties in Lithuania. The national monitoring programme handles some 90 samples each year, and the commercial services some 300 to 400.

The laboratory carries out Sr-90 determinations using scintillation counting and gamma measurements with an ORTEC gamma spectroscopy system. In addition, it maintains a network of seven NaI spectrometers in the regional food laboratories for basic food radioactivity measurements in the event of a radiological emergency.

The laboratory was inspected by the Commission in 2011, since when it has not undergone significant changes. It has the necessary equipment for receiving, storing and preparing radiological samples. A LIMS system is available for sample management. Sample measurements are carried out with an ORTEC gamma spectroscopy system (HPGe-detector and ORTEC DSPEC electronics) and liquid scintillation counter (Becman LS 6500). After counting the samples are kept for a month and then discarded.

The verification team was informed that the NFVRAI inspectors (300 inspectors altogether) are equipped to carry out emergency sampling of foodstuffs. In an emergency, the associated laboratories would use shorter counting times than usual to cope with the increased number of samples.

The verification team noted that the liquid scintillation counter is now quite old (having been installed in 1999). Therefore, it will have to be replaced in the near future (if need be, the RPC can provide back-up).

The verification team noted that there is no sample management plan for emergency situations in the laboratory. Should the number of incoming samples significantly increase, the laboratory would have problems in managing the samples and would not have sufficient counting capacity, although the EPA and RPC laboratories would share some of the workload.

The verification team recommends that the NFVRAI laboratory draft an emergency plan outlining how it would cope with an increased number of samples in the event of a radiological emergency.

The verification team suggests modernising the liquid scintillation counting equipment in the near future.

7.5.3 RPC laboratory

The RPC, through its Department of Expertise and Exposure Monitoring, is in charge of monitoring foodstuffs, mixed diet components and drinking water in Lithuania. It also provides thermoluminescent dosimeter (TLD) readings and full-body counting services for radiation workers in Lithuania and is able to carry out radon and other types of radiological analysis (mushrooms, soil, etc.). TLDs are used for long-term environmental surveillance programmes as well. The RPC has ISO 17025 accreditation. It has a staff of 50.

The laboratory was inspected by the Commission in 2011, since when it has not undergone significant changes. It remains state-of-the-art, with an impressive collection of radiological measurement capabilities, and its organisational approach is highly efficient.

The RPC laboratory has also made arrangements for emergency situations: there is a special sample receipt area for high-activity samples and the laboratory premises are equipped with a diesel generator and UPS systems for back-up power supply.

No remarks.

7.6 EMERGENCY MONITORING SYSTEMS

7.6.1 Environment Protection Agency

The verification team checked the availability of the following EPA mobile monitoring equipment:

- Mobile Envinet SARA station. The station is part of the RADIS network and can be transported quickly anywhere in Lithuania.
- CANBERRA FALCON 5000 mobile spectrometer with BE2 830-CP1 HPGe coaxial detector (relative efficiency > 20 %, FWHM at 122 keV – 0.835 keV, at 1332.5 keV – 1.768 keV) and GPS location system. The system uses special FALCON software and GENIE 2000. With this system the EPA is able to carry out nuclide identification and in-situ activity measurements in the field. Efficiency calibration of the system uses the Monte Carlo method, with ISOCS software. The detector is fully characterised and characterisation has been verified by the producer.
- CoMo 170 handheld mobile surface contamination meter (2 units available) for nuclide-specific measurement of α-, β- and γ-contamination on surfaces.

No remarks.

7.6.2 Radiation Protection Centre

The verification team verified the availability of the following RPC mobile monitoring equipment:

- RPC mobile monitoring vehicle. The air-conditioned mobile unit is equipped for air sampling and can monitor dose rate, Iodine activity and alpha/beta particulate activity mapped with GPS location data. There is also an in-situ gamma spectroscopy system. The vehicle's power generator and batteries give the laboratory around 10 hours of independent operating time.
- Envinet MONA mobile spectroscopic detection and survey system (2 units available), which can be used in land vehicles, aircrafts or watercrafts. The system is able to detect artificial radiation in the environment, coming from potential threats like nuclear incidents or accidents, non-authorised usage of radioactive sources, dirty bombs etc. It is based on a 4-litre NaI(TI) scintillation detector and includes a PC for monitoring the results and location.

- CANBERRA FALCON 5000 mobile spectrometer with HPGe coaxial detector (relative efficiency > 20 %, FWHM at 122 keV – 0.835 keV, at 1332.5 keV – 1.768 keV) and GPS location system. The system uses special FALCON software and GENIE 2000. Thanks to this system the RPC is able to carry out nuclide identification and in-situ activity measurements in the field. Efficiency calibration uses the Monte Carlo method, with ISOCS software. The detector is fully characterised and characterisation has been verified by the producer.
- ThermoFisher Scientific RIIDEye Handheld Radiation Isotope Identifier (5 units available). The system facilitates dose mapping and nuclide specification (NaI spectrum).

In addition to these systems, the RPC has several handheld radiation dose rate and contamination monitoring devices.

No remarks.

8 CONCLUSIONS

All planned verification activities were completed successfully. The information supplied in advance of the visit, as well as the additional documentation received during and after the verification activities, proved very useful.

The information provided and the verification findings gave rise to the following observations:

(1) Overall, the national environmental radioactivity monitoring programme in Lithuania complies with the requirements of Article 35 of the Euratom Treaty.

(2) The verification activities found that the facilities needed to carry out continuous monitoring of levels of radioactivity in the air, water and soil are adequate. The Commission ascertained that these facilities are in operation and running efficiently.

(3) The recommendations issued by the Commission in 2011 have been very well followed and implemented. Lithuania has in 2012 and 2015 provided follow-up reports of the 2011 recommendations.

(4) A small number of new recommendations have been formulated. They concern in particular renewal of laboratory equipment, laboratory emergency plans and national emergency stand-by arrangements. Notwithstanding these recommendations the verified parts of the national monitoring system for environmental radioactivity in Lithuania are in conformity with the provisions laid down under Article 35 of the Euratom Treaty.

(5) The team's recommendations are set out in detail in the 'Main Conclusions' document addressed to the Lithuanian competent authority through the Lithuanian Permanent Representative to the European Union.

(6) The Commission services kindly request the Lithuanian authorities to submit, before the end of 2017, a progress report on how the team's recommendations have been implemented and on any significant changes in the set-up of the monitoring systems. Based on this report the Commission will consider the need for a follow-up verification in Lithuania.

(7) The verification team acknowledges the excellent cooperation it received from all people involved in the activities it undertook during its visit.

ANNEX 1

VERIFICATION PROGRAMME

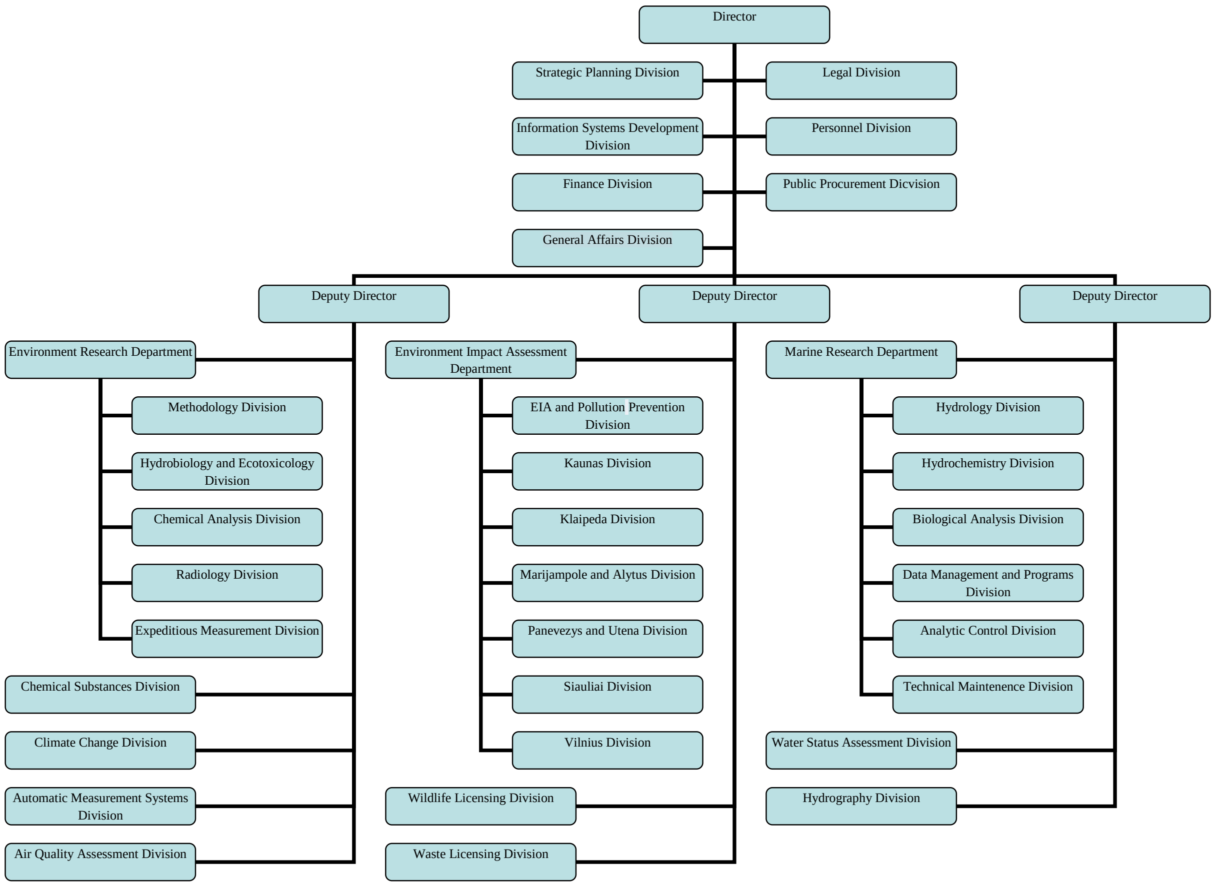
National environmental radioactivity monitoring network in Lithuania

29 November – 1 December 2016

Day/date	Time	Activity
Tuesday 29 November	10.30 – 12:00	Opening meeting (EPA Environmental Research Department, Goštauto 9-402, Vilnius)
	13:30 – 17:00	Visit to a laboratory dealing with the analysis of environmental samples (EPA Radiology Division, Rudnios 6-501) Visit to an automated airborne aerosol station in Vilnius
Wednesday 30 November	09:00 – 17:00	Inspection of automatic stations and sampling arrangements under the national environmental radioactivity monitoring programme in Vilnius and its environs Inspection of the national radiation monitoring system data centre (EPA Automatic Measurement Systems Division, Juozapavičiaus St. 9) Visit to SARA air radiation monitoring station in Vilnius Visit to SARA water radiation monitoring station in Buivydžiai Visit to SARA air radiation monitoring station in Buivydžiai
Thursday 1 December	09:00 – 10:30	Visit to the National Food and Veterinary Risk Assessment Institute (NFVRAI, J. Kairiuksčio St. 10)
	12:00 – 15:00	Visit to the Radiation Protection Centre (RPC, Kalvariju St. 153) Inspection of emergency (mobile) monitoring arrangements
	15.00 – 16.00	Closing meeting (at the RPC)

ANNEX 2A

Organisational chart of the Environmental Protection Agency



ANNEX 2B

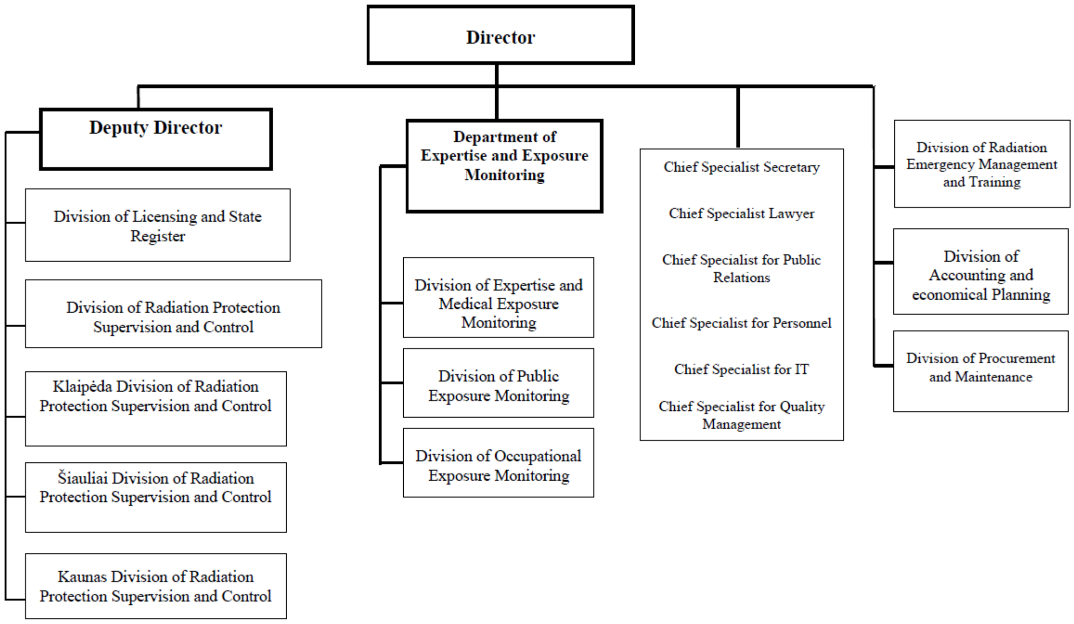
EPA Radiology Division laboratory – procedures and equipment

Procedure	Description
Sample reception	The sample registration procedure is described and included in the Environmental Research Department's quality assurance guide. All samples have sampling protocols with initial information. After inspection received samples are registered in AIVIKS (environmental information system) and marked by registration number. Information about the required analyses for certain samples is recorded in the system as well.
Sample preparation	The specialist in charge prepares the received samples for measurement in accordance with the standard requirements, documents or procedures in force (ISO 10703:2007, ISO 18589-3:2015, IEC 1452:1995, LAND 64-2005).
Sample measurements	All measurements are performed on individual samples. Measurement time is two hours for both gross beta in deposition and Sr-90. The time for gamma measurements is not pre-set; it depends on sample type, activity, etc.
Measurement devices available in the laboratory	1. Gamma spectrometer with HPGe extended range detector by CANBERRA, relative efficiency at 1.33 MeV – 34 %, FWHM at 1.33 MeV – 1.73 keV. GENIE 2000 software by CANBERRA is used to evaluate results. Efficiency calibration uses the Monte Carlo method, with Labsocs software. The detector is fully characterised and characterisation is verified by the producer. 2. Gamma spectrometer with HPGe coaxial detector GEM 40P4- 76 by ORTEC, relative efficiency at 1.33 MeV – 40 %, FWHM at 1.33 MeV– 1.85 keV. Gamma Vision-32 software by ORTEC is used to evaluate results. Efficiency calibration uses certified multiple gamma ray emitting sources with different geometry and density once a year. The laboratory also has ANGLE efficiency calibration software for HPGe detectors. 3. Thermo Scientific FHT 770T multi-low-level counter with 6 proportional flow-type counter tubes. Special software for the FHT 770T counter is used to evaluate results. Efficiency calibration with sources prepared from a standard Sr-90 solution is done once a year. Standard sources of Sr-90 and Am-241 are available at the laboratory for device checks. 4. FALCON 5000 mobile spectrometer by CANBERRA with HPGe coaxial detector BE2 830-CP1, relative efficiency > 20 %, FWHM at 122 keV – 0.835 keV, at 1332.5 keV – 1.768 keV. Special FALCON software and GENIE 2000 by CANBERRA are used. Efficiency calibration uses the Monte Carlo method, with ISOCS software. The detector is fully characterised and characterisation is verified by the producer.
Measurement results	All results are recorded in AIVIKS. Interim results are recorded in special registers. Old registers are kept for a defined time in the Environmental Research Department archive. Detection limits are calculated using measurement device software. Results under the detection limits are reported as values lower than the detection limit.
Data handling and reporting tools	Data are stored in AIVIKS, which contains registrations of samples, distribution, analysis results, confirmation of results, reports with measurement data, etc.
Statutory accounting and reporting obligations with respect to environmental sample	Results are posted on the EPA website (http://gamta.lt) and sent to all interested institutions on request. Reports on radiological monitoring data are submitted to the Commission's REM database every year. Reports on marine radiological monitoring are sent to the HELCOM database every year.

Procedure	Description
results	
Sample storage (archiving) requirements	There are no defined requirements on sample storage, but as a rule samples are kept for about 2 to 3 years in a storage room (except water samples).
Quality assurance and control procedures put in place	Internal and external quality control is performed on a regular basis. It covers evaluation of uncertainty, control diagrams, training courses, etc.
Laboratory accreditation(s) obtained and participation in national/international inter-comparison exercises or proficiency tests	The Environmental Research Department has LST EN ISO/IEC 17025:2005 standard accreditation. Additionally, laboratories in Lithuania that measure environmental samples and emissions (discharges) but do have not accreditation for certain parameters must seek a special permit for this. The EPA's Environmental Research Department is responsible for issuing these permits and has a permit itself. A special joint commission of experts from different institutions decides whether such permits should be issued to Environmental Research Department laboratories. Methods used by the Radiology Division are partly accredited (gamma spectrometry in water samples ISO 10703:2007, soil and bottom sediments ISO 18589-3:20415, biota CEI IEC 1452:1995). Moreover, quality assurance and control procedures are applied to all laboratory methods. The laboratory participates in some inter-calibration exercises organised by the IAEA, European Commission and HELCOM. In addition, the Environment Protection Agency has ISO 9001:2008 accreditation.
Outsourcing	Third parties are involved aerosol sampling and analysis under contracts. Service providers take full responsibility for taking and analysing samples and for providing data (raw data and an annual report). Additionally, they enter the measurement results in the AIVIKS environmental information system. The laboratory under contract should be accredited or have permission to perform the relevant analyses.

ANNEX 3A

Organisational chart of the Radiation Protection Centre



ANNEX 3B

RPC Department of Expertise and Exposure Monitoring – procedures and equipment

Procedure	Description
Sample reception	The RPC's quality management system meets the requirements of standard EN ISO 9001. The laboratory has ISO 17 025 accreditation (the third round of accreditation took place in 2015, the first in 2005). Sample registration and identification follows approved laboratory quality management procedures and working instructions. The laboratory has its own sample register.
Sample preparation	The RPC uses in-house sample preparation procedures created for different sample types, including working notebooks and special data sheets to record preparation data (weight of prepared sample, drying temperature and duration, ashing temperature and duration, weight of ash, total uncertainty of sample preparation, etc.). All procedures are part of the laboratory's quality management.
Sample measurements	All measurements are taken on individual samples. Only precipitation samples are integrated into one sample on a quarterly basis for gamma counting and Sr-90 measurement. Measurement time depends on sample type, activity concentration, etc.
Measurement devices available in the laboratory	1. **Low-background gamma spectrometry system**, manufactured by CANBERRA PACKARD Central Europe Gmbh. Detector model GC2 518, HPGe coaxial detector, type p: • crystal diameter 61 mm, length 38 mm • relative efficiency 25 % • FWHM 1.72 keV at 1332 keV Detector characterised by ISOCS/LabSOCS. Digital spectrum analyser DSA-1000. GENIE 2000 V3.3 analysis software 2. **Gamma spectrometry system**, manufactured by CANBERRA. Detector model GC2 020, HPGe p-type coaxial detector: • crystal diameter 55 mm, length/thickness 41.5 mm • relative efficiency 20 % • FWHM 1.79 keV at 1332 keV Digital spectrum analyser DSA-1000. GENIE 2000 V3.3 analysis software 3. **Gamma spectrometry system**, manufactured by CANBERRA. Detector model GC2 518, HPGe p-type coaxial detector: • crystal diameter 61 mm, length 38 mm • relative efficiency 25 % • FWHM 1.74 keV at 1332 keV Detector characterised by ISOCS/LabSOCS. Digital spectrum analyser DSA-1000, GENIE 2000 V3.3 analysis software 4. **Low-background gamma spectrometry system**, manufactured by CANBERRA PACKARD Central Europe Gmbh. Detector type BE3 825/S, HPGe p-type coaxial detector: • crystal diameter 70 mm, thickness 25 mm, distance to window 4.5 mm, thickness of window 0,5 mm • relative efficiency 27.3 % • FWHM 1.794 keV at 1332 keV Detector characterised by ISOCS/LabSOCS. Digital spectrum analyser DSA-1000. GENIE 2000 V3.3 analysis software 5. **Gamma spectrometry system**, manufactured by CANBERRA PACKARD Central

	Europe Gmbh. NaI(Tl) detector, type 76B76/3M-E2: • crystal 76 × 76 mm^2 • FWHM 8,0 % at 662 keV DSA-1000 digital spectrum analyser. GENIE 2000 V3.3 analysis software 6**. In-situ gamma spectrometry system**, manufactured by CANBERRA. Detector model GR5022, HPGe n-type coaxial detector: • crystal diameter 62 mm, length 60.5 mm • relative efficiency 46.1 % • FWHM 1.86 keV at 1332 keV Cryostat BIG MAC type 7935-7SL. Detector characterised by ISOCS. Digital spectrum analyser InSpector2000, GENIE 2000 V3.3 gamma analysis software 7**. Portable gamma spectrometry system Falcon,** manufactured by CANBERRA. Detector model BE2 830. HPGe n-type detector: • crystal diameter 60.8 mm, length 29.6 mm, distance from window 13.20 mm, thickness of window 1.2 mm, window material aluminium • relative efficiency 20 % • FWHM 1.77 keV at 1332 keV Cryostat model F50 00-20. Electrical cooling; detector characterised by ISOCS; GENIE 2000 V3.4 gamma analysis software **8. Thermoluminescense dosimetry system** Mirion Technologies (RADOS) TLD reader RE2 000 and TLD irradiator IR2 000; RADOS DOSACUS TLD reader RE-1 and TLD irradiator IR-1; TLD with LiF:Mg,Ti pellets 9. **Liquid scintillation counter Quantulus** 1220-003, for Sr-90/Y-90 counting by Cherenkov: background 0.77 imp/min., efficiency 62 %. For tritium counting in 20 ml plastic vial (8 ml of water sample): background 0.92 imp/min, efficiency 27.3 %. For ^{241}Am counting efficiency is 98 % 10. **Low-background proportional counting system for alpha/beta emitters**, manufactured by CANBERRA PACKARD Central, system type LBAB-CPCE 1 IN2 0-82/82; software SCARABEE Version:3.32. 16 detectors IN2 00, argon-methane gas 11. **Low-background proportional counting system for alpha/beta emitters**, manufactured by CANBERRA PACKARD Central, system type LBAB-CPCE 1 IN2 0-82/82; software SCARABEE Version:3.32. 12 detectors IN2 00, argon-methane gas. All devices have written calibration and maintenance procedures that are part of the laboratory's quality management. For internal quality assurance procedures a wide range of calibration sources and etalon sources are used; all have certificates issued by CERCA Framatome, ANP LEA, PerkinElmer and Deutscher Kalibrierdiesnst. All devices give measurement protocols, including measuring uncertainty.
Measurement results	The laboratory's quality management includes recording and archiving procedures for measurement results. Typical forms of all measurement protocols are used. The detection limit is calculated for each measurement result and is indicated in the measurement results protocol. Values lower than the detection limit are indicated as such.
Data handling and reporting tools	The RPC stores data in databases.
Statutory accounting and reporting obligations with respect to environmental sample results	Annual reports, including all results of radiological monitoring of foodstuffs and food products, are published on the RPC website at www.rsc.lt. Information on availability of data is sent by official letter to State institutions every year, including the municipalities located near the Ignalina NPP. Data are submitted to the EC REM database annually.
Sample storage	Procedure for sample storage is part of laboratory's quality management.

(archiving) requirements	
Quality assurance and control procedures put in place	Internal quality control procedures are approved for each type of measurements and are part of the laboratory's quality management. They comprise control charts, diagrams, etc.
Laboratory accreditation(s) obtained and participation in national/international inter-comparison exercises or proficiency tests	The RPC has created a quality management system as per the requirements of EN ISO 9001. The laboratory has ISO 17 025 accreditation (the first round of accreditation was performed in 2005).  REPUBLIC OF LITHUANIA NATIONAL ACCREDITATION BUREAU UNDER THE MINISTRY OF ECONOMY Lithuanian National Accreditation Bureau is a signatory of the Multilateral Agreements of the European co-operation for Accreditation (EA) for calibration, testing, inspection, certificatin of products, persons and management systems ACCREDITATION CERTIFICATE Nr. **LA.01.065** Valid until 02-02-2020 The National Accreditation Bureau hereby certifies that the ***Radiation Protection Centre*** *Kalvarijų g. 153, LT-08221 Vilnius* *complies with the requirements of LST EN ISO/IEC 17025:2005* and is accredited to carry out the tests of *the activity of concentrations of gamma radionuclides, strontium (^{90}Sr), tritium (^{3}H)and gross alpha and gross beta activity, the doses accumulated in personal dosimeters, medical diagnostic X-ray devices, dose rate and dose, surface radioactive contamination* The scope of accreditation is listed in the annex **The first Accreditation Certificate was issued 2005-02-03** Director Jurgis Šarmavičius 03-02-2015, Vilnius Participation in national and international inter-comparisons is mandatory for each type of measurement, under ISO 17025. The RPC participates in the national, IAEA, EU and NKS inter-comparisons and proficiency tests every year.
Outsourcing	All sampling and measurements for radiological monitoring are performed by the RPC staff.

ANNEX 4A

Structure of the National Food and Veterinary Risk Assessment Institute (NFVRAI)

Administration	• Finance unit • Quality management unit • Legal and personnel unit
Common affairs department	• Information unit • Information systems unit
Risk Assessment Department	• Food risk assessment Unit • Veterinary risk assessment unit • Nutrition unit
Laboratory units	• Bacteriology unit • Serology unit • Pathological anatomy and histology unit • Virology unit • Food microbiology unit • Chemistry unit • Radiology group (within chemistry unit) • Molecular biology and genetically modified organisms unit

ANNEX 4B

NFVRAI Radiology group of Chemistry unit – procedures and equipment

Procedure	Description
Sample reception	Veterinary inspectors deliver samples of milk, meat, fish, eggs and wild game to the institute from various regions of the country. At the laboratory the received samples are registered by the relevant division using the Laboratory Information Management System (LIMS). Samples are coded and delivered to the sample preparation laboratory.
Sample preparation	Sample preparation for Cs-137 analyses follows the requirements of standard procedure SDP 5.4.4.R.01:2014, drawn up according to CEI IEC 1452:1995 (Nuclear instrumentation – Measurement of gamma-ray emission rates of radionuclides – Calibration and use of germanium spectrometers). Sample preparation for Sr-90 analyses follows the requirements of standard procedure SDP 5.4.4.R.02:2014, drawn up in line with SSI-rapport 93-11 (*Methods for determination of strontium-90 in food and environmental samples by Cerenkov counting*, Swedish Radiation Protection Institute). The samples undergo radiochemical treatment; preparing a sample (prior to measurement) takes 4 to 6 days. The subsequent steps are: primary desiccation; burning in the heating oven; emission of radiochemical radio nuclides; and transfer of the sample into measuring dishes.
Sample measurements	Single samples are measured. Cs-137 is measured with a gamma spectrometer ORTEC DSPEC jr 2.0 (semiconductor detector GEM 50P4). Counting time is 43 200 seconds. Sr-90 is measured with a BECMAN LS 6500 multipurpose scintillation counter. Counting time is 100 minutes.
Measurement devices available in the laboratory	Measurements of Cs-137 are done with a gamma spectrometer ORTEC with semiconductor detector GEM 50P4, digital analyser DSPEC jr 2.0. Calibration and maintenance of the device is described in procedure QSP 5.5.R.2.4 (Maintenance of Gamma spectrometer, calibration and verification of the control). The laboratory routinely performs efficiency calibration for an energy range of 60 to 1820 keV by using certified multi-nuclide standards (59 to 1836 keV). GAMMA VISION 6.01 analysis software is used to evaluate the results; Report Writer 2.03 is used to process and print the results. Afterwards they are analysed, entered into the LIMS system and reported in the investigation protocol. Sr-90 is measured with a BECMAN LS 6500 multipurpose scintillation counter. The calibration and maintenance of the scintillation counter is done in line with procedure QSP 5.5.R.2.2 (Technical maintenance and calibration of scintillation counter Beckman LS 6500). Certified single isotope standards are used for calibration. Measurement data are evaluated manually on an Excel sheet using QSF 4.12.2.R.1-1 – the Sr-90 analysis scoring form. This form is checked monthly through manually performed formula-based calculations.
Measurement results	All analysis results are entered into the LIMS system and reported in the investigation protocol. Measurement results are recorded and archived in accordance with the procedures laid down by the institution: • QSP 4.12.2.R.1 Primary and secondary data registration • QSP 5.8.1.R.1 Handling of analyses, identifying analyses, registration and reporting of results • QSP 4.12.3 Work with LIMS program

Data handling and reporting tools	Requirements for data handling and reporting are described in the procedures drawn up by the institution: • QSP 4.12.2 R.1 Primary and secondary data registration. • QSP 5.8.1.R.1 Handling of test, identifying test, registration and, reporting results • QSP 4.12.3 Work with LIMS program
Statutory accounting and reporting obligations with respect to environmental sample results	Reporting is performed to the requirements of Government Resolution No 388 (2004, last amended in 2010) on approval of the procedure for the submission of reports concerning the implementation of European environmental protection legislation to the European Commission and the European Chemical Materials Agency, and on the supply of information need to draft reports to the European Environmental Protection Agency
Sample storage (archiving) requirements	The procedure containing requirements for sample storage is drawn up by the institution: • QSP 5.8.2.R.1 Storage and destruction of samples
Quality assurance and control procedures put in place	Quality assurance and control procedures are applied at the laboratory in accordance with the requirements described in the procedures drawn up by the institution: • QSP 5.9.3.R.1 Quality assurance for analyses • QSP 5.9.1.R.1 Drawing up control diagrams • QSP 5.6.1R.3 Using control sample
Laboratory accreditation(s) obtained and participation in national/international inter-comparison exercises or proficiency tests	The laboratory has LST EN ISO/IEC 17025:2005 accreditation. The accreditation was given by the Lithuanian National Accreditation Bureau. The certificate has registration number LA.01.139 and is valid until 5 May 2020. In 2007 the Institute was licensed to use the International Laboratory Accreditation Association Label - – ILAC.
Outsourcing	Sub-contractor services are not used for radiological analyses.