EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY

Directorate D – Nuclear Energy
Radiation protection

TECHNICAL REPORT

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

LITHUANIAN NATIONAL MONITORING NETWORK FOR ENVIRONMENTAL RADIOACTIVITY

REPUBLIC OF LITHUANIA

19 - 23 September 2011

Reference: LT-11/05

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

FACILITIES	Monitoring networks for environmental radioactivity in Lithuania
	Radioanalytical laboratories associated with environmental and foodstuffs radioactivity monitoring
	Medical facilities using radioactive substances
SITES	Utena, Ignalina, Turmantas, Rimse, Vilnius, Kaunas
DATE	19 – 23 September 2011
REFERENCE	LT-11/05
INSPECTORS	V. Tanner (team leader)
	C. Hanot
	G. Simeonov (trainee)
DATE OF REPORT	23 December 2011

SIGNATURES

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TECHNICAL REPORT

ABBREVIATIONS

DG ENER	Directorate-General for Energy
DAKKS	Deutsche Akkreditierungsstelle (GmbH)
EC	European Commission
EPA	Environment Protection Agency
EURDEP	European Radiological Data Exchange Platform
FWHM	Full Width at Half Maximum
GM	Geiger-Müller
HELCOM	Helsinki Commission
HPGe	High Purity Germanium
IAEA	International Atomic Energy Agency
ISO	International Standardization Organization
NFVRAI	National Food and Veterinary Risk Asessment Institute
EIA	Environmental Impact Assessment
PMS	Permanent Monitoring Station
RPC	Radiation Protection Centre
TLD	Thermo Luminescent Dosimeter
UPS	Uninterruptible Power Supply

1. INTRODUCTION

Article 35 of the Euratom Treaty requires that each Member State shall establish facilities necessary to carry out continuous monitoring of the levels of radioactivity in air, water and soil and to ensure compliance with the Basic Safety Standards[(1)].

Article 35 also gives the European Commission the right of access to such facilities in order that it may review and verify their operation and efficiency.

For the EC, the Directorate-General for Energy and in particular its Radiation Protection Unit (ENER.D.4) is responsible for undertaking these verifications.

The main purpose of verifications performed under Article 35 of the Euratom Treaty is to provide an independent assessment of the adequacy of monitoring facilities for (as far as applicable in the Member State):

- Liquid and airborne discharges of radioactivity into the environment by a site (and control thereof).
- 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.

For the purpose of such a review, a verification team from DG ENER visited monitoring sites, as well as the laboratories which are part of the national monitoring system for environmental radioactivity. The visit included meetings with representatives from the Environmental Protection Agency (EPA) and Radiation Protection Centre (RPC) as well as with representatives from the National Food and Veterinary Risk Assessment Institute (NFVRAI). With due consideration to the scope of the verification mission and taking into account the relatively short time available for the execution of the programme, it was agreed that emphasis would be put on:

- Selected environmental radioactivity monitoring arrangements in Utena, Ignalina, Vilnius and Kaunas
- National environmental monitoring and sampling programme
- Discharge monitoring at the Institute of Oncology of Vilnius University
- Analytical laboratory of the Environmental Protection Agency
- Analytical laboratory of the Radiation Protection Centre
- Analytical laboratory of the National Food and Veterinary Risk Assessment Institute

The present report contains the results of the verification team's review of relevant aspects of the environmental surveillance of radioactivity on the territory of Lithuania. The report is also based on information collected from documents received and from discussions with various persons met during the visit.

The verification team acknowledges the excellent co-operation it received from all participating individuals.

[1] Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the health protection of the general public and workers against the dangers of ionizing radiation (OJ L-159 of 29/06/1996, page 1).

2. PREPARATION AND CONDUCT OF THE VERIFICATION

2.1. General

The Commission's decision to require the conduct of verifications under the terms of Article 35 of the Euratom Treaty was notified to the Lithuanian Government on 31 January 2011 (letter referenced ENER/D4/CG/cn Ares(2011)85343, addressed to the Permanent Representative of Lithuania to the European Union). The Lithuanian Government designated the Environmental Protection Agency (EPA) to lead the technical preparations for this visit. Subsequently, practical arrangements for the implementation of the verification were made with the EPA.

2.2. Preparatory documents

In order to facilitate the work of the verification team, a package of information was supplied in advance by the Lithuanian authorities, in the form of answers to a questionnaire prepared by the Commission services. Additional documentation was provided during and after the verification visit. The information provided has been extensively used for drawing up the descriptive sections of this report.

2.3. Programme of the visit

A programme of verification activities under the terms of Article 35 was discussed and agreed upon with the Lithuanian competent authority (EPA).

The programme comprised verification of the monitoring arrangements at stations belonging to the national monitoring system, at three participating laboratories and at the Oncology Institute of the Vilnius University.

A summary overview of this programme of verification activities is provided in Appendix 2. The verification activities were carried out in accordance with this programme. At the locations listed in the programme the verification activities addressed technical aspects of monitoring and sampling, analytical methods, quality assurance and control, archiving and reporting of data.

On 19 September, an opening meeting was held at the EPA headquarters. The closing meeting was held at the RPC laboratory on 23 September.

2.4. Representatives of the Lithuanian competent authorities and the associated laboratories

Environmental Protection Agency (EPA)

Ms. Aldona Margeriene	Deputy Director
Radiology Division	
Dr. Beata Vilimaite Silobritiene	Head of Division
Mr. Gintautas Berlinskas	Chief Specialist
Ms. Laimute Jociene	Specialist
Ms. Irena Sliuozaite	Senior Specialist
Environmental Status Assessment Department	
Automatic Measurement Systems Division	
Mr. Juozas Molis	Head of Division
Mr. Vaidotas Uselis	Chief Specialist
Mr. Aurelijus Jurkus	Chief Specialist

Radiation Protection Centre (RPC)

Department of Expertise and Exposure Monitoring
Mr. Julius Žiliukas — Head of Department

Division of Public Exposure Monitoring
Ms. Rima Ladygienė — Head of Division
Ms. Auksė Skripkienė — Chief Specialist
Ms. Laima Pilkytė — Chief Specialist

Division of Occupational Exposure Monitoring
Ms. Aušra Urbonienė — Chief Specialist
Ms. Nijolė Senovaitytė — Chief Specialist

National Food and Veterinary Risk Assessment Institute (NFVRAI)

Laboratory Department
Radiology Section
Mr. Pranas Drulia — Head of Section

The verification team acknowledges the excellent co-operation it received from all individuals mentioned.

3. BACKGROUND INFORMATION

3.1. General

In Lithuania there are no operational nuclear power plants or research reactors; the Ignalina plant was shut down in 2009. There are no operational reactors in the neighbouring territories either.

Lithuania and all its neighbouring countries (Latvia, Poland, Russia and Belarus) have active nuclear power development programmes and nuclear power remains a credible policy option for their future energy supply. Russia and Belarus have advanced plans for locating new reactors close to the Lithuanian border (Kaliningrad and Ostrovets NPPs). Lithuanian authorities are already preparing a radiological baseline survey in the Lithuanian territories close to the future NPP sites.

Surveillance of artificial radiation and artificial radionuclides is included in the monitoring of radioactivity in the environment and foodstuffs. Exposure to natural radiation is controlled by research activities in case of suspicion that natural radionuclides may cause unusually high exposure of the public (e.g. indoor radon and natural radionuclides in drinking water).

3.2. Responsible organisations

Three institutions in Lithuania are responsible for the implementation of the national radiological monitoring programme:

- The Environmental Protection Agency (EPA) under the Ministry of Environment performs monitoring of radioactivity in air, water and atmospheric deposition. It has also a network of automatic gamma dose rate measurement stations.
- The Radiation Protection Centre (RPC) under the Ministry of Health performs monitoring of foodstuffs, vegetation and drinking water.
- The National Food and Veterinary Risk Assessment Institute (NFVRAI) under the State Food and Veterinary Service performs monitoring of raw foodstuffs and feedingstuffs.

Each institution has its own analytical laboratory for radiological investigations:

- EPA – Radiology Division in Environmental Research Department;
- RPC – Department of Expertise and Exposure Monitoring;
- NFVRAI – Radiology Unit in the Laboratory Department.

4. LEGAL PROVISIONS FOR ENVIRONMENTAL RADIOACTIVITY MONITORING IN LITHUANIA

4.1. General

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. The latest update of three of the main laws shifts, as of October 2011, responsibilities for discharge licensing and supervision from EPA to the RPC (non-nuclear facilities) and to the State Nuclear Power Safety Inspectorate VATESI (nuclear facilities).

The broader national legal framework for radiological monitoring of environment, foodstuffs and discharges is defined by the following three major laws:

- Law on Environmental Monitoring (No VIII-529, 1997, last amended in 2006 No X-595);
- Law on Environmental Protection (No I-2223, 1992, last amended in 2011);
- Law on Radiation Protection (No VIII-1019, 1999, last amended in 2011).

4.2. Legislative acts regulating environmental monitoring

In addition to the laws listed in 4.1, the following legislative acts establish the responsibilities of the various Lithuanian authorities and organizations for radiological monitoring of the environment:

- National Environmental Monitoring Programme 2011-2017, approved by Government Resolution No 315 (2011);
- Government Resolution No 388 (2004, last amended in 2010) on confirmation of the order of reports related to implementation of European legislation in the field of environmental protection to the European Commission and the European Chemicals Agency and presentation of information required for preparation of reports to the European Environmental Protection Agency;
- Order of the Ministers of Health and Environment No 528/490 (2002) on approval of the order of organization and implementation of state radiological monitoring and presentation of its data to the state institutions, the European Commission and the public;
- Order of the Minister of Health No V-312 (2004) on approval of requirements for monitoring of foodstuffs and concentrations of radionuclides in the precipitation and ambient gamma dose equivalent in the Ignalina and Kupiškis districts;
- Order of the Ministers of Environment and Health No 584/486 (2003) on sampling in case of radiological or nuclear accident;
- Government Resolution No 653 (1999, amended in 2004) on regulations for licensing the practices involving sources of ionizing radiation;
- Government Resolution No 578 (1998) on approval of general regulations for dosimetric control in the case of radiological accident;
- Resolution No 280 (2005) on approval of regulations on handling of illegal sources of ionizing radiation and contaminated facilities;

- Hygiene standard HN 73:2001 Basic standards for radiation protection;
- Hygiene standard HN 87:2002 Radiation protection in nuclear facilities;
- Hygiene standard HN 112:2001 Requirements for monitoring of internal exposure;
- Hygiene standard HN 99:2000 Protective measures of population in case of radiological and nuclear accident;
- Hygiene standard HN 24:2003 Safety and quality requirements of drinking water;
- Hygiene standard HN 85:2003 Natural exposure; Standards of radiation protection.

4.3. Legislative acts regulating foodstuffs monitoring

In addition to the three main laws listed in 4.1, the following legislative acts establish the responsibilities of the various Lithuanian authorities and organizations for radiological surveillance of foodstuffs:

- Government Resolution No 388 (2004, last amended in 2010) on confirmation of the order of reports related to the implementation of European legislation in the field of environmental protection to the European Commission and the European Chemicals Agency and presentation of information required for preparation of reports to the European Environmental Protection Agency;
- Order of the Ministers of Health and Environment No 528/490 (2002) on approval of the order of organization and implementation of state radiological monitoring and presentation of its data to the state institutions, the European Commission and the public;
- Order of the Minister of Health No V-312 (2004) on approval of requirements of carrying out of radiological monitoring of foodstuffs and concentrations of radionuclides in atmospheric precipitations and the monitoring of gamma dose equivalent in the districts of Kupiškis and Ignalina.

4.4. Legislative acts regulating the radiological surveillance of hospital discharges

In addition to the three laws mentioned in 4.1, the following legislative acts regulate the radiological surveillance of hospital discharges in Lithuania:

- Law on the Management of Radioactive Waste (Nr VIII-1190, 1999, last amended in 2011);
- Government Resolution No 653 (1999, amended in 2004) on regulations for licensing the practices involving sources of ionizing radiation.

The responsibilities of the various actors in this domain are established in Normative Document LAND 41 (2010) on limitation of radioactive discharges from companies, medical, educational and scientific institutions, governmental and municipal institutions and order of granting of permits for discharges.[(2)]

[2] This regulatory document was replaced very soon after the verification (1st October 2011). Part of the document related to the granting of permission for discharges and control of discharges was moved to the Order of the Minister of Health "On approval of the Order of Granting Permits for Discharges to environment from Medical, Industrial, except objects of nuclear energy, Agricultural objects and during performance of Scientific research" (No V-900. 2011) and the part related to environmental monitoring (both monitoring of impact on environment and monitoring of discharges) was moved to the Order of the Minister of Environment "On approval of regulation of environmental monitoring of economic entities" (No D1-546, 2009, last amended 2011).

4.5. Guidance documents relevant to the environmental radiation monitoring

There are no national guidance documents relevant to the environmental radiation monitoring. Relevant recommendations issued by the European Commission and the International Atomic Energy Agency are followed.

5. ENVIRONMENTAL RADIOACTIVITY MONITORING IN LITHUANIA

5.1. External ambient gamma dose rate

The Automatic Measurement Systems Division (AMSD) of EPA has the task to organize the network of automatic radiation monitoring stations. In order to accomplish the task, the RADIS group within AMSD performs day-to-day duties of maintenance and supervision of the network equipment, organises calibration and repair work, performs analysis and controls the primary data.

There are three networks for monitoring ambient gamma dose rate in Lithuania: the PMS, ALNOR and AGIR networks. Table I summarises the technical data of these networks. Figure 1 shows the locations of the stations. There are plans to install new stations at the national border close to the future nuclear sites in Kaliningrad and Belarus.

Station type	Number of stations	Measurement type	Measurement range:	Equipment
PMS (Permanent Monitoring Station)	9 (not all operational)	Gamma dose rate NaI spectrum Temperature Rain intensity	0.05 μSv/h – 1 Sv/h (gamma dose rate)	Multi Chanel Analyzer (PCA-P) with TB2 module (made by Ofxord company) and 3x3" NaI detector ALNOR/RADOS Geiger-Müller tube (RD-02L) 3 thermometers (Pt-100) rain intensity probe (dripping-bucket system, not heated)
ALNOR (also called AAM-95)	3	Gamma dose rate	0.05 μSv/h – 1 Sv/h (gamma dose rate)	ALNOR/RADOS Geiger-Müller tube (RD-02L)
AGIR (Lithuanian acronym of Automatic Registration of Gamma Radiation Intensity)	10 (not all operational)	Gamma dose rate	0 μSv/h – 0.35 Sv/h (gamma dose rate)	30x25mm SRP-68-01 NaI detector with photo-multiplier tube

Table I. Summary of gamma dose rate monitoring networks

The stations send data through the GSM network and internet to the central servers in the EPA RADIS centre, where the data is made available through the authority network to local and remote users (RPC and VATESI). Data is sent to the European EURDEP system on an hourly basis.

PMS stations are designed to provide a NaI spectrum and monitor also rain intensity and temperature, but in practise these data are received only from part of stations and are available only for specialists. Spectrum is received upon request from all PMS stations except Vilnius, Turmantas and Rimse. All necessary meteorological data are received form meteorological stations. Therefore, in essence, all three networks provide the same type of data to the central server.

The alarm threshold for gamma dose rate in Lithuania is 300 nSv/h. If this threshold is reached at any measurement location, an alarm notice is sent to a predefined list of staff of the Lithuanian institutions. There is also a lower threshold for gamma dose rate (200 nSv/h). In this case an alarm notice is sent only to RADIS staff within the AMSD.

The automated monitoring system is linked into the Danish Emergency Management Agency database (ARGOS network - bilateral data exchange and co-operation agreement).

Measurements are made in 10-minute periods and transferred to the Vilnius central data collection system. Data are made public at http://radis.gamta.lt with a maximum delay of 20 minutes. All collected data are electronically archived in SQL databases.

The three networks are fairly old and their functionality is partially constrained. There are also concerns about reliability and operability during power cuts. The EPA has initiated a programme to replace two automatic monitoring networks (PMS and ALNOR) and modernise the data centre.

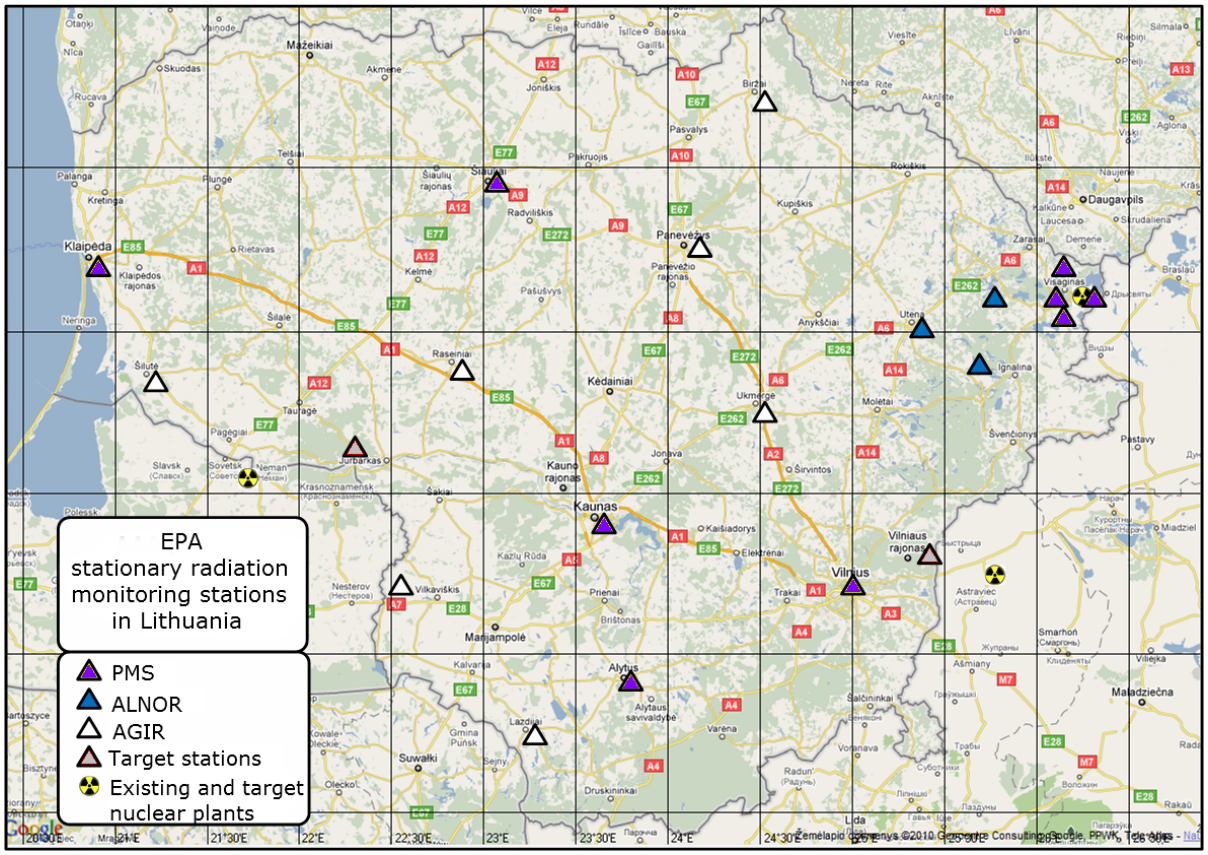

Figure 1. Automatic gamma dose rate monitoring stations in Lithuania

5.2. External ambient gamma dose

RPC carries out external gamma dose measurements using TLD detectors. Measurements are performed in Vilnius, Kaunas, Šiauliai, Klaipėda and Panevėžys areas (10 monitoring points in each location) and Ignalina and Kupiškis districts (16 monitoring points in each district). TLD dosimeters with LiF pellets are used. Dose is measured every 6 months. Kupiškis district is considered a clean area without any nuclear activities, i.e. providing a baseline for the Ignalina area measurements.

TLD locations are unmarked and open to public access. RPC staffs in charge of the monitoring programme use GPS coordinates to find the TLDs. Figure 2 presents the monitored areas and their measured average annual doses in 2010.

Figure 2. TLD measurement areas and their measured average doses in 2010 (mSv)

5.3. Radioactivity concentration in air

EPA samples airborne radioactivity concentration in Utena. Two high-volume air samplers are located at the Utena Regional Environment Protection Department, some 60 km from the Ignalina NPP.

Particulate filter samples are changed every 3-4 days and sent to the EPA laboratory in Vilnius for analysis (Cs-137, Be-7, other gamma). Activated charcoal filters are used for I-131 measurements on a monthly basis. Sampling frequency can be increased in the event of an emergency.

Until 2010 air radioactivity concentration was measured also in Vilnius, but thereafter financial restrictions limited the programme to Utena only. A procurement notice has been issued in 2011 for renewal of the sampling equipment.

5.4. Airborne deposition

Deposition (dry and wet) is collected in five locations (Vilnius, Kaunas, Klaipeda, Utena and Dukstas). The samplers are located at meteorological monitoring sites. Sampling cloths (textile) are changed every five days by the personnel of the meteorological stations (Hydrometeorology Service under Ministry of Environment) and sent via mail to the EPA laboratory in Vilnius for gross-beta measurement.

The RPC operates a simple dry-wet deposition collector, installed at the premises of the RPC in Vilnius. The device consists of a heated deposition collection vessel (rain water collector). Sampling is done monthly. Deposition samples are measured for gross alpha and gross beta; integrated samples (quarterly) are monitored for gamma and Sr-90 activity.

5.5. Surface water

EPA is responsible for determination of activity of radionuclides in surface water from lakes and rivers. Sampling is performed by the Expedition Measurements Division (EPA Environmental Research Department), Marine Research Department (EPA) or Regional Environment Protection Departments under the Ministry of Environment. Sampling (60 litres) is carried out in three lakes (2-6 samples/year) and six rivers (4 samples/year). Samples are measured for Sr-90 and Cs-137.

Sediments are sampled from the same sites 2-4 times per year. One sample of biota is taken once per year from the lake Druksiai. Samples are measured for total gamma and Sr-90 in the EPA laboratory.

5.6. Soil monitoring

RPC carries out a soil sampling programme started in 2007, including Vilnius, Ignalina, Švenčionys and Zarasai districts. Sampling of vertical distribution of artificial radionuclides up to a depth of 30 cm is performed. At each location, three samples are taken from undisturbed soil. Samples are cut to 5 cm slices and measured with gamma spectrometry.

5.7. Marine monitoring

EPA is responsible for marine monitoring. Sampling is done by the EPA Marine Research Department; sample preparation and measurements are done at the EPA radioanalytical laboratory. Sometimes a representative of the laboratory participates in sampling expeditions. 60 litre samples (surface and bottom water) are taken from four sites 1-4 times per year. Samples are measured for Sr-90 and Cs-137. EPA samples also marine sediments from the same four sites three times per year. In addition one or more samples of biota (plants, fish) are taken from the sea. Samples are measured for total gamma and Sr-90 in the EPA laboratory. Results are reported to the HELCOM database.

5.8. Ground water and drinking water

RPC is responsible for radiological monitoring of ground water and drinking water. There are two different networks for monitoring: the dense (quarterly sampling) and sparse (monthly sampling). Dense network includes six sampling locations: Ignalina NPP region (Ignalina, Zarasai and Utena districts) and other regions of country (Kaunas, Klaipėda and Šiauliai). In the Vilnius region drinking water samples are taken monthly (sparse network). Sampling includes three samples of water from private wells and one from the public water supply system. Samples are measured for gross alpha/beta and tritium.

5.9. Milk produced in Lithuania

RPC is responsible for milk sampling and radiological monitoring. Fresh milk samples from local production are collected quarterly from six different regional sites (Ignalina, Zarasai and Utena districs, Kaunas, Klaipėda and Šiauliai cities) (farms, dairies, markets, etc.). In Vilnius samples are collected monthly. Samples are measured for gross alpha/beta, Cs-137, Sr-90 and K-40.

5.10. Foodstuffs and mixed diet

RPC is responsible for mixed diet and foodstuffs sampling and radiological monitoring. Raw local foodstuffs and food products are sampled from six sites across the country (Ignalina, Zarasai and Utena districts, Kaunas, Klaipėda and Šiauliai rities). Samples of meat and fish are collected twice a year and samples of vegetables and grain once a year. Mixed 24-hour diet samples are collected monthly from Vilnius. All samples are monitored for gross alpha/beta, Cs-137, Sr-90 and K-40.

5.11. Food of animal origin

NFVRAI is responsible for monitoring of raw foodstuffs and feedingstuffs. The sampling programme is defined annually by the Director of the State Food and Veterinary Service. The programme consists of poultry, beef, pork, milk, fish, eggs, wild game, etc. Samples are collected from various regions of the country and delivered by veterinary inspectors working for the agencies of the State Food and Veterinary Service. Samples are monitored for Cs-137 and Sr-90.

5.12. Food from natural ecosystems

Since 1997 the RPC has collected mushrooms and wild berries for Cs-137 activity measurements. All edible kinds of mushrooms are collected. Annually during summer and autumn more than 300 mushroom samples are collected from more than 30 forests in 17 districts.

5.13. Mobile monitoring systems

EPA monitoring vehicle

EPA has a four-wheel drive monitoring vehicle, equipped with an Exploranium GR-660 Multidetector system. It is possible to monitor while the vehicle is in movement (alternation of energetic spectrum, activity of particular radioactive nuclides and location of the vehicle). The vehicle also has a portable Exploranium GR-130 EnviSpec instrument for monitoring on foot. Data can be transferred to a PC for later use or storage. This portable instrument is not equipped with a GPS.

RPC monitoring vehicle

RPC has a mobile laboratory equipped with a power supply, air conditioning and filtering systems. The vehicle has equipment for measurement of air radionuclide activity concentration (Berthold). Air suction and counting of beta/gamma activity concentration in air and radioactive iodine dose rate measurement devices allow measurements during travel using GPS location information. In-situ gamma spectrometer is also available (relative efficiency 51.1%, Genie 2k analysis software). Counting by in-situ gamma spectrometry is not possible when the vehicle is in motion.

6. MONITORING OF DISCHARGES FROM NON-NUCLEAR FACILITIES USING RADIOACTIVE SUBSTANCES

There are fourteen non-nuclear facilities using unsealed radioactive substances in Lithuania (2010) including six hospitals, five educational and research institutions and three governmental institutions. The majority of the radioactive material is used in hospitals for diagnostic and treatment purposes and the radionuclides present are mostly short-lived. The effluents are almost entirely liquid; they are discharged into the municipal wastewater system, not directly to the environment.

The discharges from all non-nuclear facilities in Lithuania are below the nationally established exemption limits and therefore discharge authorization and radiological monitoring are not required in practice. Nevertheless, since June 2010, an obligation of annual reporting of the estimated amount of discharged activity is in place.

In June 2010 the responsibility for the regulation, authorization and supervision of the radioactive discharges to the environment was shifted from the Ministry of Environment to the EPA. Another change took place in October 2011 when these responsibilities were be assumed by the RPC.

7. VERIFICATION ACTIVITIES

7.1. Structure of the national monitoring programme

Based on the information provided by the Lithuanian authorities, the verification team verified the structure of the national environmental radiation measurement programme. No major planning deficiencies were identified; the programme covers all the environment monitoring compartments and is also geographically well designed. Especially the use of TLDs for long term gamma dose surveillance and the preparatory steps already taken to monitor areas close to future nuclear sites in Kaliningrad and Belarus should be complimented. A minor improvement could be to include monitoring of rain water in the EPA programme.

However, the verification team points out that although the structure of the programme is very good, financial constraints have severely limited its implementation. Especially the automatic dose rate monitoring network is in poor condition and needs to be modernised. It would be good to increase the number of air sampling systems, especially there should be one in the Vilnius area. In addition, having three different authorities (EPA, RPC and NFVRAI), each with their own analytical laboratory, in charge of programme implementation is hardly an optimal solution; although in Lithuania the tasks of different organisations appear to be well defined.

The verification team was informed that the results of the monitoring programme are made available on the Environment Protection Agency website and reported to the associated services and the European Commission REM database according to Article 36 of the Euratom Treaty. Information on marine environment can be found also in the HELCOM website and HELCOM reports. There is no annual official public report prepared on radiation in the Lithuanian environment.

> *The verification team recommends full modernisation of the automatic radiation dose rate monitoring network and increasing the number of high-volume air sampling systems.*
>
> *The verification team suggests the EPA improve the availability of official information on environmental radiation in the public domain.*

7.2. EPA laboratory

General

The verification team visited the EPA radiological laboratory, which has recently been refurbished and has been operational since July 2011. The laboratory carries out measurements as part of the implementation of the annual monitoring plan established by the Ministry of Environment. It functions as a measurement laboratory - it does not carry out any analysis of the measurement results. The current laboratory staff consists of four persons, two of them trained for gamma spectroscopy and three for beta counting.

The laboratory is modern and clean, but not quite finished yet. Essentially the sample database is still missing; existing database covers only keeping of final results, but not full information on samples. The project on the sample database is underway and should be finished in 2012.

The number of samples measured is quite low (only environment samples as part of the national programme, no commercial samples are accepted). When the laboratory is ready it apparently has capacity to increase the number of measurements carried out.

The laboratory is not accredited, but the intention is to achieve accreditation in the future. A quality manual was presented to the verification team. The laboratory has participated in several international intercomparison exercises (IAEA, EC, HELCOM).

> *Verification does not give rise to particular recommendations. The verification team supports the intention to obtain accreditation for the laboratory.*

Sample receipt, pre-treatment and weighting

In most cases sampling is done by the regional environment protection departments or other government services (Hydrometeorological Institute). Control samples from the Ignalina NPP area are taken by the laboratory staff themselves. Samples are received, numbered and recorded in the laboratory logbook. Records are kept on paper; the electronic database is still in the testing phase.

Samples arrive with their sampling data sheets. Written instructions for sample receipt are available. Typical samples received in the laboratory are 60 litre water samples, aerosol sampling filters, deposition filters, biota and sediment samples.

The laboratory has two sample scales located in a temperature and humidity controlled room, but during the verification only one was in working order. There is a regular control programme for the scales and an annual verification and calibration contract with the Lithuanian Metrological Service.

> *Verification does not give rise to particular recommendations. The verification team supports the project for implementing an electronic sample database for the laboratory.*

Ashing, drying and pressing

The laboratory has two ashing and two drying furnaces and a sample press. Typically the deposition samples are ashed and sediment/biota samples dried (a few days of drying is required until sample mass is stable). Aerosol filters are pressed to powder.

> *Verification does not give rise to particular remarks.*

Radiochemical laboratory

The room where radiochemical separations take place is equipped with charcoal filters in incoming air channels to prevent outside contamination. Written work instructions are available for the staff.

Verification does not give rise to particular remarks.

Gamma spectrometry

The laboratory has an Ortec gamma spectroscopy system. The system consists of a 40% relative efficiency HPGe detector and an Ortec D-Spec analyzer unit. UPS is available to provide electrical back-up (max 20 minutes). A weekly control programme for detector efficiency is in place, but the controls do not include peak width (FWHM) and energy stability controls.

The verification team recommends the EPA laboratory to consider adding regular controls of peak width and energy stability in the HPGe-detector control programme.

In order to ensure continuous operation of the laboratory, the team suggests adding a second gamma spectroscopy system.

Beta counting

The laboratory has a Thermo Scientific FHT 77T Multi Low Level Counter for beta counting (3x2 sample positions). The system efficiency is controlled annually with standard sources.

In order to ensure continuous operation of the laboratory, the team suggests adding a second beta counting system.

Standards

For calibration the laboratory has three commercial gamma standard sources. In addition a standard liquid source has been acquired for preparing liquid standards in different measurement geometries. A Sr-90/Am-241 standard is available for the beta counter. Activity certificates were presented to the verification team. Standards are kept in a locked cabinet. There is no activity standard for gamma spectrometry on aerosol filter samples; the efficiency calibration is based on point source measurements combined with a Monte Carlo simulation.

The verification team suggests carrying out measurements to validate the efficiency calibrations based on Monte Carlo simulations.

Sample archiving

Dry samples are kept in labelled plastic boxes in a storage room for three years. Water samples are not stored.

Verification does not give rise to particular remarks.

7.3. RPC laboratory

General

The RPC, through its Department of Expertise in Exposure Monitoring, is in charge of foodstuffs, mixed diet and drinking water monitoring in Lithuania. The RPC also provides TLD dosimetry reading and full-body counting services for radiation workers in Lithuania and is also able to carry out radon and other types of radiological analysis (mushrooms, soil, etc.). TLDs are used also for long-term environmental surveillance programmes. In addition to the Lithuanian national measurements also contract measurements for Latvian and Estonian programmes are carried out. RPC is accredited to ISO 17025 (second round of accreditation completed in 2010). It has a staff of 50. The laboratory produces an annual report summarising the results of its monitoring activities [3].

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.

Verification does not give rise to particular remarks.

Sample receipt and pre-treatment

In most cases the RPC staffs take the samples themselves according to written instructions. Samples are received in a separate sample entrance area, where they are registered in the laboratory database and assigned a colour code according to sample handling (*keep for storage, urgent, return, high dose rate, etc.*). Each sample receives a three letter code, which identifies the type of sample and type of measurement. A refrigerator and a freezer are available. A data back-up is performed monthly.

The team verified the equipment, the instructions for sample receipt and the instructions provided to laboratory customers.

Verification does not give rise to particular remarks.

Sample preparation

The sample preparation room has two drying ovens, a furnace and two evaporation systems for sample treatment. Scales and pipettes have calibration logs and certificates available. Each work procedure is documented in a specific work instruction.

The radiochemistry room is well equipped for carrying out radiochemical operations (Sr-separation, Cherenkov counting, Tritium sample preparation, etc). The room is equipped with a special water showering system to clean the exhaust gases released in the fume chambers.

Verification does not give rise to particular remarks.

Gamma spectrometry

The equipment in the gamma spectroscopy room consists of one Oxford and three Canberra detectors. In addition, the laboratory has one portable Canberra system and one NaI detector for Cs-137 measurements in food. HPGe detectors have relative efficiencies of 20%, 25%, 25% and 27.3%. The counting room is monitored for radon, dose rate, temperature and humidity.

Gamma spectroscopy system efficiency calibrations are done using standard calibration sources for all measurement geometries. Standards are kept in a separate locked storage room. Calibration controls are done once a week. The control includes peak efficiency (cps), gamma energy (keV) and peak width (FWHM) controls.

Verification does not give rise to particular remarks.

Alpha/beta counting

Total alpha and beta measurements are done using two Canberra IN20 Alpha-Beta multidetector systems. Sr-90/Y-90 and H-3 counting is done with a Quantulus 1220-003 Ultra low-level liquid scintillation spectrometer. The alpha/beta counting room has an additional temperature and humidity control system. Equipment calibration and quality control certificates were made available to the verification team.

Verification does not give rise to particular remarks.

TLD reader room (Occupational exposure monitoring)

The laboratory has two RADOS TLD readers and one TLD irradiation device. TLDs are used for both personnel and environmental dose measurement purposes. Some 11 000 TLDs are read annually for occupational dose and some 200 for environmental dose. TLD readers are calibrated annually by the Lithuanian National Metrological Laboratory. Intercomparison exercises are organised among similar laboratories in the Baltic States.

Verification does not give rise to particular remarks.

7.4. NFVRAI laboratory

General

The verification team visited the NFVRAI radiological laboratory which carries out measurements on samples of animal origin based on an annual programme defined by the Director of the State Food and Veterinary Service. The samples are collected by veterinary inspectors from various regions and counties in Lithuania. The programme includes some 90 samples each year. Elevated levels of Cs-137 have been found a few times in imported meat and berries.

The laboratory is very modern and clean; it has been operative since 1997. It also performs commercial analyses on request.

Since 2005, the laboratory has been accredited in accordance with standard ISO/IEC 17025-2005. The accreditation was performed by German accreditation service DAKKS. Additionally the institute is accredited by the Federal Centre of Hygiene and Epidemiology (FGUZ) in the Russian Federation. The laboratory produces an annual report summarising the results of its monitoring activities [2].

Verification does not give rise to particular remarks.

Sample receipt and pre-treatment

Samples are delivered by the veterinary inspectors from various regions of the country. They are registered on the Laboratory Information Management System (LIMS), then coded and sent to the sample preparation laboratory in sealed bags.

Verification does not give rise to particular remarks.

Ashing and drying

Sample preparation is done according to written standard procedures. The laboratory is equipped with a furnace which can be used to dry five samples at a time. Afterwards the ashes are transferred to small dishes for measurement.

Verification does not give rise to particular remarks.

Scales

The laboratory is equipped with a calibrated scale to weight the samples. The scale is calibrated twice a year. A written work procedure is available for sample weighting and scale calibration.

Verification does not give rise to particular remarks.

Gamma spectrometry

The laboratory has an Ortec gamma spectrometer for measurement of Cs-137 activity. Typically 12 hours counting time is used. The system consists of a HPGe semiconductor detector system GEM 50P4 (57% relative efficiency) and GammaVision 6.01 analysis software. Calibration and maintenance is described in a written procedure. The laboratory performs routine efficiency and energy calibration of the system by using certified multi-nuclide standards, but does not control the detector resolution (peak width).

The verification team recommends the NFVRAI laboratory to consider adding regular controls of peak width stability (FWHM) in the HPGe-detector control programme.

Liquid scintillation counting

The laboratory is equipped with a liquid scintillation counter Beckman LS6500 for measuring Sr-90 and Tritium activity. Written procedures are available for calibration and maintenance. Measurement data are encoded manually in an Excel database. This form is checked monthly according to manually performed calculations.

Verification does not give rise to particular remarks.

Standards

For calibration of the gamma spectroscopy system the laboratory uses certified multi-nuclide sources. For the calibration of the scintillation counter, certified single isotope standards are used. Some sources for calibration are shared between the different laboratories (EPA and RPC).

Verification does not give rise to particular remarks.

Results archive

The results are recorded electronically using the Laboratory Information Management System. They are also recorded manually on the sample receipt sheet. A report is completed, checked by the Head of section and signed by the authorized person. It is then sent to the person or institution requesting the analysis; in the case of radioactivity monitoring to the Veterinary Service.

The measurement results are archived in accordance with written procedures and the analysed samples are kept for one month in a freezer for possible re-analysis. For analyses for Russian clients, this period is extended to 3 months. If the activity exceeds the exemption level, the sample is treated as radioactive waste following a written procedure.

Verification does not give rise to particular remarks.

7.5. Automatic measurement networks

7.5.1. PMS network

The verification team verified the PMS monitoring stations in Turmantas, Rimse, Kaunas and Vilnius.

PMS stations in Lithuania are old and all the verified stations were in poor condition. The only data still produced by these stations is ambient gamma dose rate; other functionalities (temperature, rain detection, NaI spectra) are either not used or not produced at all due to technical failures. Lack of maintenance is apparent: stations' outer paint has peeled off, some of the wooden structures were damaged and the rain buckets were blocked. Batteries supplying back-up power were missing in Turmantas.

Stations are typically located on the rooftops of public buildings. The verification team noted that the physical access to the stations was difficult and unsafe in most cases.

The verification team recommends urgent and complete refurbishment of the automatic radioactivity monitoring stations.

The verification team recommends that the maintenance procedures of the monitoring stations be reviewed and arrangements made for continuous maintenance of the stations.

The verification team recommends reviewing the functionality and safety of physical access to each automatic station.

7.5.2. ALNOR network

The verification team verified the ALNOR network stations in Utena and Rugistaiskis. These stations are old, but due to simple and robust design still in good working order. The station in Rugistaiskis is equipped with a local dose rate display.

There appears to be no common Lithuanian guideline for the siting of the dose rate stations, for example providing minimum distance to buildings, installation height etc.

Verification does not give rise to particular recommendations. The verification team suggests studying relevant EU studies (Airdos-study) on station siting before installing new stations.

7.5.3. AGIR network

The verification team did not verify any stations of the AGIR network, but based on the information provided and the data available at the network data centre it appears that this network is not operational.

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.

7.5.4. Network data centre and communication systems

The verification team verified the data centre of the automatic monitoring networks at the EPA. It was found that the centre is currently based on one PC-server, which connects to the monitoring stations via Internet. There are no efficient back-up arrangements for communication or electrical power, only

a small UPS is available for the server. There is a graphical interface to network results; the dose rates can be monitored through the EPA public website and the EURDEP website. No alerting mechanism is in place for high radiation values.

Only dose rate values are received from the network; the additional data collected by the PMS stations (NaI spectra, rain intensity and temperature) are not retrieved.

Technical status of the network data centre is poor, even though the system is able to provide dose rate data for national monitoring and the EURDEP system. There are serious concerns on reliability, alerting, data handling, communication arrangements and electrical power back-up.

> *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.*

7.6. Air sampling

The verification team verified the air sampling systems at the EPA Regional Environmental Laboratory in Utena, which is currently the only air sampling site in Lithuania. There are two sampling systems: a high-volume 'SnowWhite' system and a medium volume 'Hunter' system. During the verification the Hunter system was operational; the SnowWhite system was shut down to save electrical power. The team was informed that the SnowWhite system was in good working order and would be started in the event of a radiological emergency.

The sampling site has electrical back-up only for computers, not for the pumps in the air samplers.

7.6.1. Hunter system

The Hunter JL-150 system installed on the roof of the building has particulate and charcoal filters. The particle filter is changed twice a week and the charcoal filter on a monthly basis. During an emergency the filters can be changed more frequently. Filters are changed by the local staff, documented and sent to the EPA radiological laboratory for measurement. Record of filter changes was presented to the verification team.

7.6.2. SnowWhite system

The Snow White JL-900 high-volume air sampling system is installed on on the roof of the building. The station measures independently the filtered air volume and operation time. The filter (Whatman GF/A glass fibre 46x57 cm) is changed weekly by the local staff and sent by mail to the EPA laboratory in Vilnius along with a sampling information sheet.

> *Verification does not give rise to particular recommendations. The verification team suggest EPA to consider installing an electrical back-up system for the air samplers.*

7.7. External ambient gamma dose monitoring

The verification team verified the TLDs located in a forest about 1 km from the Ignalina NPP (Station #1). There are two TLD capsules (each capsule contains 4 pellets) placed on trees a few meters apart, providing back-up for each other in case something happens to either of the capsules. The GPS based location system was demonstrated to the verification team.

> *Verification does not give rise to particular remarks.*

7.8. Deposition sampling

The verification team verified the deposition samplers in Utena and Kaunas. The samplers are located in fenced meteorological instrument gardens operated by the Lithuanian Hydrometeorological Centre. Both samplers use 65x65 cm sampling cloth, which collects both dry and wet deposition. The cloth is replaced every five days and sent in a plastic bag to the EPA laboratory in Vilnius. Measurement results provide a nuclide specific qualitative indication of the combined dry/wet deposition.

Verification does not give rise to particular remarks.

7.9. Mobile measurement systems

The verification team verified the RPC mobile monitoring laboratory. 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. Vehicles power generator and batteries allow for some 10 hours independent operation time for the laboratory.

Verification does not give rise to particular remarks.

7.10. Monitoring of discharges from medical facilities

The verification team visited the Institute of Oncology of Vilnius University, which is the biggest user of unsealed radioactive substances in Lithuania and the only medical facility where inpatients are treated with radioisotopes. The nuclear medicine department can accommodate up to twelve patients simultaneously; typical duration of hospitalization is three days. All the liquid waste from toilets and showers is collected and stored for decay in two underground concrete tanks of 150 m^3 each before being released to the city wastewater system. The tanks, installed in 2009, are equipped with remotely operated level gauges, gamma dose rate monitors and cleaning systems. When one of the tanks becomes full, it is closed and all liquid waste is then collected in the second tank. The release from the first tank takes place when the second one is full. Typically the cycle is repeated every ten to twelve weeks, thus allowing for longer decay time before the release to the city wastewater system. Authorities are not notified of individual releases.

According to the hospital's quality assurance procedures, a sample is taken from the tank before each release and a written protocol, including a record of gamma dose rate measurement at the sample's surface, is issued. As of 2010, discharges are reported annually to the RPC using an RPC-approved methodology to calculate the activity of the different radionuclides.

Gaseous radioactive discharges from the medical facility are insignificant and hence not controlled. This situation may change in future should a new PET facility be installed in the Institute of Oncology (under consideration).

Verification does not give rise to particular remarks.

8. CONCLUSIONS

All verification activities that had been planned were completed successfully. In this regard, the information supplied in advance of the visit, as well as the additional documentation received during and after the verification activities, was useful.

The information provided and the verification findings led to the following observations:

(1) The verification activities that were performed demonstrated that the facilities necessary to carry out continuous monitoring of levels of radioactivity in the air, water and soil with regard to the surveillance of the Lithuanian territory are adequate. The Commission could verify the operation and efficiency of these facilities.

(2) However, several important recommendations are formulated, essentially concerning the automatic radiation dose rate monitoring network, which needs to be upgraded to ensure its continued operation. These recommendations do not detract from the general conclusion that the Lithuanian national monitoring system is in conformity with the provisions laid down under Article 35 of the Euratom Treaty.

(3) The recommendations presented in this report are summarized in the 'Main Findings' document that is addressed to the Lithuanian competent authority through the Permanent Representative of Lithuania to the European Union.

APPENDIX 1

REFERENCES AND DOCUMENTATION

1. Questionnaire on the implementation of Article 35 of the Euratom Treaty in the Republic of Lithuania, EPA, 2011

2. Report on trends of prevalence of animal diseases, zoonoses and zoonotic agents, food contaminants and undesirable substances in feed in 2010 in Lithuania, National Food and Veterinary Risk Assessment Institute, June 2011

3. Annual report 2010, Radiation Protection Centre, ISSN 2029-1078

APPENDIX 2

VERIFICATION PROGRAMME

EURATOM Article 35 Verification in Lithuania
19 to 23 September 2011

Monday 19 September – Opening meeting

14:30 – 17:00 Opening meeting at EPA
- Introductions
- EC Art 35 presentation
- Discussion on the program of the verification visit

Tuesday 20 September – Environmental monitoring

08:00 – 17:00 Monitoring systems at Utena and at the surrounding area of the Ignalina NPP
- Utena: Ambient dose rate, aerosol, deposition
- Ignalina: TLD
- Turmantas: PMS

Wednesday 21 September – Environmental monitoring and analytical laboratories

08:00 – 13:00 Monitoring systems in Kaunas and Vilnius
- Kaunas: PMS, deposition
- Vilnius: Ambient dose rate, deposition

14:00 – 17:00 Laboratory of the National Food and Veterinary Risk Assessment Institute (NFVRAI)

Thursday 22 September – Analytical laboratories and medical facilities

09:00 – 13:00 Laboratory of the Environmental Protection Agency (EPA)

14:00 – 17:00 Vilnius University Institute of Oncology

Friday 23 September – Analytical laboratories and Closing meeting

09:00 – 12:00 Laboratory of the Radiation Protection Centre (RPC)

15:00 – 16:00 Closing meeting at RPC
- Presentation of preliminary verification results