EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY AND TRANSPORT

DIRECTORATE H - Nuclear Energy
Radiation Protection

TECHNICAL REPORT

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

IGNALINA NUCLEAR POWER PLANT

LITHUANIA

21 to 25 February 2005

Reference: LT-05/1

VERIFICATION UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

FACILITIES:	Installations for monitoring and controlling radioactive discharges and for surveillance of the environment in Lithuania during normal operations of the Ignalina nuclear power plant
SITE:	Ignalina
DATE:	21 to 25 February 2005
REFERENCE:	LT-05/1
INSPECTORS:	Mr C. Gitzinger (Head of team) Mr S. Van der Stricht Mr V. Tanner Mr P. Beuseling Mr Y-H. Bouget (national expert on secondment – France) Ms A. Godeanu Metz (trainee)
DATE OF REPORT:	01/04/2006 - final report agreed upon with the Lithuanian authorities.

SIGNATURES:

[signed]	*[signed]*
C. Gitzinger	**S. Van der Stricht**
[signed]	*[signed]*
V. Tanner	**Y-H Bouget**
[signed]	*[signed]*
A. Godeanu Metz	**P. Beuseling**

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TECHNICAL REPORT

1 ABBREVIATIONS

DG TREN	Directorate-General for Transport and Energy of the EC
EC	European Commission
EPA	Environmental Protection Agency
FWHM	Full width ad half maximum
IAEA	International Atomic Energy Agency
INPP	Ignalina Nuclear Power Plant
IoPh	Institute of Physics
MRC	Marine Research Centre
QMS	Quality Management System
NPP	Nuclear Power Plant
PMS	Permanent Monitoring Station
RADIS	Automatic Measurement Systems Division
RBMK	Channelised Large Power Reactor (Russian acronym)
RPC	Radiation Protection Centre
RSCR	Radiation Safety Control Room (of the INPP)
TLD	Thermo-luminescent dosimeters
VATESI	State Nuclear Power Safety Inspectorate (Lithuanian acronym)

2 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 standards [(1)].

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

For the EC, the Directorate-General for Transport and Energy (DG TREN) and more in particular its Radiation Protection Unit (TREN H4) 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:

- Liquid and airborne discharges of radioactivity into the environment by a nuclear 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.

A verification team from DG TREN visited from 21 to 25 February 2005 the site of the Ignalina nuclear power plant located in the east of Lithuania. The team consisted in two sub-teams, one dealing with radioactive discharges (Team 1) and the other with environmental monitoring (Team 2).

The visit also included meetings with representatives of various national authorities having competence in the field of radiation protection. A closing meeting was held, with all parties involved during the visit, at the premises of the Radiation Protection Centre (RPC) of the Ministry of Health at Vilnius.

The present report contains the results of the verification team's review of relevant aspects of the environmental surveillance at and around the Ignalina site, as well as national radiological surveillance in general.

The present report is also based on information collected from the documents received and from discussions with various persons met during the visit.

3 PREPARATION AND CONDUCT OF THE VERIFICATION

3.1 Preamble

The Commission's decision to request the conduct of an Article 35 verification was notified to the Permanent Mission of Lithuania to the European Union by letter TREN.H4 SVdS/iw D(2004)6155.

Subsequently, practical arrangements for the implementation of the verification were made with the Lithuanian competent authorities at a meeting held at the Lithuanian Permanent Representation in Brussels on 13 September 2004. At this meeting, the EC delegation presented the scope and conduct of its verification activities. The Lithuanian competent authorities provided preliminary information

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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).

on the Lithuanian legislation and its implementation with respect to radiation protection, as well as an overview of the Ignalina nuclear power plant site.

3.2 Programme of the visit

At the preparatory meeting held in Brussels, a programme of verification activities under the terms of Art. 35 was discussed and agreed upon with the Lithuanian delegation.

The agreed programme comprised:

- The verification of liquid and gaseous radioactive discharges from the Ignalina NPP (sampling and monitoring systems, analytical methods, quality assurance and control aspects, reporting).
- The verification of the environmental radiological monitoring programmes as implemented by:
    i. The Ignalina NPP.
    ii. The Environmental Protection Agency of the Ministry of the Environment, located in Vilnius.
    iii. The Radiation Protection Centre of the Ministry of Health, located in Vilnius.

  At these locations, the verification addressed technical aspects of monitoring and sampling activities, analytical methods used, quality assurance and control, archiving and reporting.

On 21 February, an opening meeting was held at the Ignalina NPP where the operator and the competent authorities made presentations on the following topics:

- The national environmental monitoring programme in Lithuania, presented by the Environmental Protection Agency (EPA) and the Radiation Protection Centre (RPC).
- The Lithuanian nuclear emergency preparedness and the national radiological surveillance system by the Environmental Protection Agency (EPA).
- The Ignalina NPP (INPP) general presentation.

A summary overview of the programme of verification activities is provided in Appendix 1 to this report.

The verifications were carried out in accordance with the programme.

3.3 Documentation

In order to facilitate the work of the verification team, a package of information was supplied in advance by the Lithuanian authorities. Additional documentation was provided during and after the visit. All documentation received is listed in Appendix 2 to this report. The verification team notes the quality and comprehensiveness of all the presentations made and the documentation provided.

The information thus provided has been extensively used for drawing up the descriptive sections of the report.

3.4 Representatives of the competent authorities and the operator

During the verification visit, the following representatives of the national authorities, the operator and other parties involved were met:

State Nuclear Safety Inspectorate (VATESI)

Mr. Vidas Paulikas	Head of the Decommissioning and Radiation Protection Division

Mr. Nikolai Polushkin	VATESI Group at INPP, Chief Inspector, On-site Division
Mr. Edmundas Vaitkus	Senior Inspector, Decommissioning and Radiation Protection Division

Ignalina Nuclear Power Plant

Representatives mainly interfacing with the Discharge Team:

Mr. Kestutis Gediminskas	Head of Radiation Protection Department
Mr. Valery Zyk	Deputy Head of Radiation Protection Department
Mr. Vladimir Putincev	Senior Engineer
Mr. Alexander Litvinov	Head of Effluent Laboratory
Mr. Sergei Bormotov	Chief Engineer of Gamma Spectrometry Group
Ms. Tatiana Zyk	Radiochemictry Engineer
Ms. Tatiana Litvinova	Chief Engineer of Airborn Monitoring Group
Mr. Nickolai Nesterov	Head of Repair Service
Ms. Tatjana Stepanec	Interpreter

Representatives mainly interfacing with the Environmental Team:

Mr. Oleg Miroshnik	Deputy Head of Radiation Protection Department
Mr. Igor Gubačiov	Head of Environmental Protection Laboratory (EPL)
Mr. Ruslan Jerenkevič	EPL Chief Engineer
Ms. Olga Pletniova	EPL Gamma Spectrometry Engineer

Ministry of the Environment, the Environmental Protection Agency Laboratory

Mr. Gintautas Berlinskas	Head of Radiological Division
Mr. Linas Juknevičius	EPA, RADIS group
Mr. Vaidotas Uselis	EPA, RADIS group
Ms. Irena Šliužaitė	Chemist
Ms. Jolanta Dvinelytė	Assistant

Ministry of Health, the Radiation Protection Centre

Mr. Albinas Mastauskas	Director
Mr. Gendrutis Morkūnas	Deputy Director
Ms. Rima Ladygiene	Head of Subdivision of Radiological Investigations, Quality Manager, Technical Manager for Tritium Counting
Ms. Auksė Skripkienė	Chemist, Technical Manager for Sr-90 analysis by Liquid Scintillation Counting
Ms. Laima Pilkytė	Engineer, Technical Manager for Gamma Spectrometry
Ms. Birutė Gricienė	Head of Subdivision of dosimetry, Technical Manager for Dosimetric Measurements with the TLD system, ambient Gamma Dose Rate Measurements
Ms. Vida Žukauskaitė	Assistant, performing Sample Registration, Sample Preparation and gross Alpha and Beta Counting

3.5 Ignalina nuclear power plant

3.5.1 Geographical location

The Ignalina Nuclear Power Plant (INPP) is the only nuclear power station in Lithuania.

It is situated at approximately 500 m from the southern shore of Lake Drūkšiai (26^{o} 34’N, 55^{o} 36’E) and 39 km from the municipality of Ignalina (Utena district). The nearest township is Visaginas (population 32.600) at 6 km from the power plant. The nearest large urbanisations are Vilnius, the capital of Lithuania, 130 km to the South-East, and Daugavpils in Latvia, located at 30 km to the North. Other neighbouring countries are the Russian Federation (Kaliningrad District), Belarus and Poland, situated in the South, and Byelorussia situated in the East.

3.5.2 Summary description of the power plant

Since Lithuania's independence in 1991, INPP became a State owned enterprise. At the same time Lithuania set up its own inspectorate, the Lithuanian Nuclear Power Safety Inspectorate (VATESI in Lithuanian) to oversee the plant.

INPP consists of two units, commissioned in December 1983 and August 1987 respectively. Currently Unit 2 is operational; Unit 1 was shut down on 31 December 2004. It is planned to shut down also Unit 2 in 2009. Unit 3 was constructed to a very advanced stage, but the project was discontinued after the reactor accident at Chernobyl in 1986.

Both units are ex-Soviet designed RBMK-1500 reactors (channel-type reactor, water-cooled and graphite-moderated) and differ from the RBMK-1000 plants operating in Russia and Ukraine, not only by a higher nominal power level, but also by several improved safety features. These improvements were conducted under the supervision of VATESI and were made possible through international cooperation and assistance programmes.

Main technical attributes of the Unit 2 of the Ignalina NPP:

Thermal reactor power	4800 MWth (design) - 4200MWth (actual)
Electric power output	1500MWe (design) - 1300 MWE (actual)
Number of primary loops	2
Pressure in the primary circuit	70 bar
Average temperature of the primary coolant	260-285°C
Height/diameter of the pressure core	7 m / 11,8 m
Fuel enrichment U-235	2.4% to 2.6%
Number of channels	1661
Number of turbines per unit	2

4 COMPETENT AUTHORITIES AND NUCLEAR LEGISLATION

4.1 Authorities and Responsible Ministries

4.1.1 Introduction

The first regulatory system in terms of nuclear safety that met international requirements was created in 1991 after Lithuania regained its independence from the former Soviet Union. The country undertook a commitment whilst operating INPP not to put in danger the population and the environment, as well as to use nuclear materials and technologies for peaceful purposes only.

Responsibility for the operation of the nuclear power plant rests with the Ignalina Nuclear Power Plant State Enterprise.

4.1.2 The State Nuclear Safety Inspectorate (VATESI)

The State Nuclear Safety Inspectorate (VATESI) was created on 18 October 1991 by Governmental Resolution.

The most important tasks of VATESI are to regulate:

- Nuclear safety at the Ignalina Nuclear Power Plant State Enterprise (and other nuclear facilities).
- The safety of radioactive waste management in nuclear facilities.
- The safe use of nuclear materials.
- The physical protection of nuclear facilities and nuclear/radioactive materials.
- Radiation protection at the Ignalina Nuclear Power Plant State Enterprise (and other nuclear facilities).

VATESI issues operating licences for all nuclear related facilities and has the right to suspend or discontinue these in case of serious violations. The Head of VATESI is appointed and dismissed by the Prime Minister of the Republic of Lithuania. Most of the VATESI staff work in Vilnius, although they also run an office on the INPP site (on-site inspectorate).

4.1.3 Responsible ministries

The ministries involved in the radiological protection are as follows (see also Appendix 3):

- The Ministry of Health, through its Radiation Protection Centre (RPC) is responsible for the regulatory control of radiation protection; nation-wide assessment of exposure of the population, radiation workers and patients from different sources including exposure of the population from local food products, mixed diet and drinking water; and in case of necessity prepares recommendations to the effect of optimising radiation protection measures. RPC also provides expertise for the decision makers within the regulatory authorities, and participates in the preparation of legal texts.
- The Ministry of the Environment, through its Environmental Protection Agency (EPA) is responsible for the nation-wide monitoring of gamma dose rate and assessment of radioactivity in the air, surface waters, soil and sediments. EPA also prepares the legal acts and normative documents and issues permits for release of radioactive substances into the environment.

Both ministries, in close cooperation, are responsible for the implementation of the national environmental radioactivity monitoring programme and for performing independent regulatory control over the Ignalina NPP statutory environmental monitoring programme.

In addition to the Ministries mentioned above, the Civil Defence Department of the Ministry of the Interior also has competencies in radiological protection, mainly on matters of emergency preparedness in case or radiological accidents.

4.2 Legislation

The Law on Nuclear Energy, the Law on Radioactive Waste Management, and the Law on Radiation Protection represent the main body of primary legislation regulating the nuclear sector in Lithuania.

In addition, there are a number of other Laws and Governmental Resolutions that regulate the handling of nuclear materials and determine the rules for protecting the general public, workers and the environment against the dangers of ionizing radiation.

The most relevant legal texts are listed below:

- Law on Radiation Protection (Nr VIII-1019, 1999, as amended in 2004)
- Law on Nuclear Energy (Nr I-1613, 1996, as amended in 2004)
- Law on the Management of Radioactive Waste (Nr VIII-1190, 1999, as amended in 2004)
- Law on Environmental Protection (Nr I-2223, 1992, as amended in 2004)
- Law on Environmental Monitoring (Nr VIII-529, 1997, as amended in 2003)

- Government Resolution Nr 578 (1998) 'On the Approval of General Regulations for Dosimetric Control in the Case of Radiological Accident'
- Government Resolution Nr 653 (1999) 'On Regulations for Licensing the Practices Involving Sources of Ionizing Radiation'
- Order of ministers of health and environment Nr 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, European Commission and public'
- Government Resolution Nr 651 (1999) 'On the Establishment of the State Register of Radiation Sources and Exposure of Workers and Approval of its Statute'

Also, a number of 'Hygiene Norms' adopted by the Ministry of Health define and lay down general requirements for the monitoring of exposure and radioactive contamination, determine permissible levels of radioactive contamination of different items, etc.

The following Hygiene Norms are of particular interest:

- Hygiene standard HN 73:2001 'Basic Standards for Radiation Protection'
- Hygiene standard HN 87:2002 'Radiation Protection in Nuclear Facilities'
- Hygiene standard HN 99:2000 'Protective measures for the population in case of radiological and nuclear acccident'

HN 73:2001 sets the dose limit for INPP personnel and outside workers at 100 mSv for any five-year period. The annual effective dose cannot exceed 50 mSv per year (dose limitation), provided that the average annual dose does not exceed 20mSv for any 5 consecutive years.

The requirements laid down in Hygiene standard HN 87:2002 are in compliance with International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS No. 115, Vienna, IAEA, 1996) and the 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 ionizing radiation. HN 87:2002 establishes dose constraints for members of the public. The annual effective dose constraint for members of public due to INPP operation is 0.2 mSv. This annual dose constraint is the basis upon which the INPP discharge limits for airborne and liquid releases of activity into the environment are calculated (see below).

Normative Documents (national standards) have been issued that deal with levels (and limits) of natural and artificial radioactivity. Discharges of radioactivity into the environment are regulated through these legally binding texts. Relevant in the framework of this report is the normative document LAND 42-2001 on the "Limitation of Radioactive Discharges from Nuclear Facilities, on Permitting of Discharges and on Radiological Monitoring". LAND 42-2001 is based on and implements the Law on Environmental Protection (Nr I-2223, 1992, as amended in 2004). The requirements of LAND 42-2001 apply to nuclear facilities in their design and construction phase as well as their operational life and subsequent decommissioning. This normative document regulates the operation of nuclear facilities under normal conditions, including short-time anticipated operational transients, and it is not applicable for accidents.

The main legal documents concerning national environmental surveillance are the Law on Environmental Monitoring (1997 - amended in 2003) and the National Environmental Monitoring Programme (1999-2004), approved in 1998. The next programme will cover the period 2005-2010.

A comprehensive list of the above legislation plus other normative and national standards is provided in Appendix 2.

5 CONTROL OF RADIOACTIVE DISCHARGES

5.1 Provisions for discharge monitoring

Limits for liquid and airborne discharges of radioactivity into the environment have been established in accordance with normative document LAND 42-2001, issued by the Minister of the Environment (July 2001) and agreed upon by both the Minister of Health and by VATESI.

Radioactive substances may not be released into the environment (in liquid, gaseous or solid form) without having obtained a prior authorisation from the competent regulatory authority. Such an authorisation can only be obtained by submitting an application to the Ministry of the Environment. This application must include the planned radioactive discharges as well as a plan for radiological monitoring. The activity released shall not exceed the discharge limits that are specified in the authorisation obtained.

Furthermore, LAND 42-2001 requires the INPP to:

- Report its monthly discharges of activity into the environment (source term) to the Ministry of the Environment, the Radiation Protection Center of the Ministry of Health and to VATESI.
- Produce an annual report with the results of the environmental radiological monitoring programme in the region around the INPP (impact assessment). This report is addressed to the Ministry of the Environment, the Radiation Protection Centre of the Ministry of Health and to VATESI.
- In the occurrence of a daily release of activity exceeding 1% of the annual discharge limit, the INPP has to duly inform the Ministry of the Environment, explaining the reasons of the event.
- In the occurrence of a monthly cumulative release of activity exceeding 25% of the annual discharge limit, the INPP has to duly inform the Ministry of the Environment, explaining the reasons of the event and detailing the countermeasures that will be taken to prevent recurrence as well as to reduce further discharges in order to ensure that the annual limit is abided by.

5.1.1 Airborne discharges

Cumulative annual airborne discharge limits:

Type of release	Release limit Bq/year
IRG (inert radioactive gases)	$1.39*10^{16}$
Radioactive aerosols	$9.40*10^{11}$
Radioactive iodine-131	$9.87*10^{11}$

Further discharge limitations (per day and per month) are laid down in a document entitled 'Technical Specifications when operating the RBMK-1500 reactor at the Ignalina NPP'. The document is approved by the INPP Director-General, in coordination with the Head of VATESI.

The annual discharge limits for specific radionuclides, as well as the daily and monthly limits, are given in Appendix 5 to this report.

5.1.2 Liquid discharges

The INPP takes/returns its cooling water from/to Lake Drūkšiai.

In 1995, INPP stopped discharging its radioactive process waters into the lake due to the commissioning and subsequent operation of two 5000 m^3 water storage tanks. This allowed INPP to improve the management of its radioactive process water recycling capabilities, especially during outage periods.

All radioactive process waters are collected in a treatment plant (building 150). After decontamination these waters are, as far as possible, recycled for internal use. Any liquid radioactive waste that remains is then transformed (bituminised) into solid waste for intermediate storage.

The only discharges of potentially contaminated liquid effluents that are produced are:

- Reactor building process waters from various heat exchangers.
- Water treatment plant (building 150) process waters.
- Laundry water (discharged into household sewage system after evaporation).
- On-site central heating plant leakage waters.
- Unbalanced [(2)] waters (discharged into the surface draining channel).

Despite having stopped discharges of radioactive process waters into the lake, the discharge limitation on liquid releases remaines in force unaltered. The cumulative liquid activity discharge limit into Lake Drūkšiai is set at 3.358 E+13 Bq/year (the limits for specific radionuclides are given in Appendix 5 to this report).

5.2 Principal discharge sources

Preliminary remark: Unit-1 was shut down at the end of the year 2004.

Before the shutdown of Unit-1, the three main contributors to discharges of radioactivity into the environment under normal operation are the ventilation stacks on buildings 101/1 and 101/2 (reactor buildings: discharges of noble gas, aerosols and iodines - stack height 150 m) and the ventilation stack on building 150 (liquid waste treatment plant, common to both reactors: discharges of aerosols and iodines - stack hight 75 m).

The 101/1 and 101/2 ventilation stacks contributed 98-99 % of the total discharges, whereas the 150 ventilation stack contributed approximately 0.5 %.

A series of smaller stacks are also present on other buildings that release small quantities of aerosols. These stacks are very minor contributors when compared to those on buildings 101/1-2 and 150.

Radioactive discharges via the 101/1, 101/2 and 150 stacks are monitored with automated on-line systems. Provisions for sampling the discharges are also present and samples are analysed in a dedicated laboratory.

The 101/1 and 101/2 stacks consist of three individual vent ducts. These individual ducts contribute to the total volume discharged in the proportion 55/100, 25/100 and 20/100. Sampling is performed in each of these three ducts, at the 90 m level, by 8 sampling nozzles distributed over the radius of the duct, within a laminar flow domain. These three primary sampling lines are then combined into one single master sampling line that feeds the on-line monitoring and related sampling devices. There are two such sampling line systems in place, fully segregated and separately feeding the RKS-07P and RKS 03-01 monitoring systems (see below). Air flows through the stacks and through the sampling lines are continuously monitored and the flow data registered. The sampling systems are designed to function in an isokinetic manner.

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2 The term ‘unbalanced waters’ is to be understood as clean waste water generated during the liquid radioactive waste treatment process, this water - if not used - can be discharged into the lake as such.

The 150 stack consists of one single vent duct. Sampling is however performed within the horizontal part preceding the stack proper, by 6 sampling nozzles that combine into one sampling line feeding the on-line monitoring and related sampling devices. Air flows through the stacks and through the sampling lines are continuously monitored and the flow data registered. The sampling system is designed to function in an isokinetic manner.

The following radionuclides are mainly identified in the airborne discharges of the INPP:

- Noble gas: Xe-133, Xe-133m, Xe-135, Xe-135m, Xe-138, Kr-85m, Kr-87, Kr-88 and Ar-41.
- Particulates: Cs-137, Fe-59, Co-60, Zr-95 and Nb-95.
- Iodine: I-131, I-132 and I-133 (10% aerosol-bound, 60% molecular, 30% organic).

5.3 Monitoring and sampling devices

5.3.1 Buildings 101/1 and 101/2 (reactor buildings)

Continuous on-line monitoring of noble gas, aerosol and iodine total activities is implemented through two radiometric systems known as RKS 03-01 and RKS-07P (hereafter RKS-3 and RKS-7). RKS-3 and RKS-7 function in parallel (redundancy) whereby RKS-3 acts as a back-up to RKS-7.

Both RKS-7 and RKS-3 systems also provide sampling facilities for noble gas (collection tanks of 0.5 and 6.2 dm³), aerosols (filter type AFA-RPM-20) and iodines (100 cm³ charcoal filter, impregnated with silver nitrate). These samples are sent to the effluent laboratory for analysis and subsequent accountancy of the discharge.

Both RKS-7 and RKS-3 are fed by fully separated sampling line systems.

5.3.1.1 RKS-7

The basic characteristics of the system are:

Monitored item			lower limit Bq/m³	upper limit Bq/m³
I-131	high sensitivity, 24 hour integration	beta	0.16	$3.7*10^4$
I-131	low sensitivity, 24 hour integration	gamma	7.4	$1.4*10^5$
Noble gas	low sensitivity, cumulative value since beginning of the day	beta	(Xe-133) $1.4*10^5$ (Kr-85) $6.3*10^4$ (Ar-41) $6.3*10^4$	$3.7*10^{11}$ $2.4*10^{14}$ $2.4*10^9$
I-131	cumulative value since beginning of the day	gamma	41	$1.0*10^5$
Noble gas	high sensitivity, cumulative value since beginning of the day	beta	(Xe-133) $7.8*10^3$ (Kr-85) $1.2*10^4$ (Ar-41) $1.4*10^4$	$1.1*10^9$ $1.6*10^9$ $2.1*10^9$
Aerosols (long-lived)	value in real time	beta	0.16	$3.7*10^4$
Aerosols (long- and short-lived)	cumulative value since beginning of the day	beta	5.2	$3.7*10^4$

Cont'd

Noble gas	low sensitivity, value in real time	beta	(Xe-133) $1.4*10^5$ (Kr-85) $6.3*10^4$ (Ar-41) $6.3*10^4$	$3.7*10^{11}$ $2.4*10^{14}$ $2.4*10^9$
Noble gas	high sensitivity, value in real time	beta	(Xe-133) $7.8*10^3$ (Kr-85) $1.2*10^4$ (Ar-41) $1.4*10^4$	$1.1*10^9$ $1.6*10^9$ $2.1*10^9$

All measurement channels of RKS-7 relay visual and acoustic alarm signals into the Radiation Safety Control Room. Alarm values are pre-set for warning and emergency levels (Bq/m³):

Monitored item		Channel	Warning	Emergency
I-131	high sensitivity	0	0.7	17.4
I-131	low sensitivity	1	0.7	17.4
Noble gas	low sensitivity, cumulative	2	$3.5*10^4$	$3.5*10^5$
I-131	cumulative	3	0.7	17.4
Noble gas	high sensitivity, cumulative	4	$7.0*10^3$	$3.5*10^5$
Aerosols (long-lived)	real time	5	0.7	26
Aerosols (long- and short-lived)	cumulative	6	0.7	26
Noble gas	low sensitivity, real time	7	$3.5*10^4$	$3.5*10^5$
Noble gas	high sensitivity, real time	8	$7.0*10^3$	$3.5*10^5$

5.3.1.2 RKS-3

The basic characteristics of the system are:

Monitored item	Measurement range (Bq/m³)
Short-lived aerosols ($T_{1/2}$ <24 hours)	from $2.5*10^1$ to $5*10^5$
Long-lived aerosols ($T_{1/2}$ >24 hours)	from $5*10^{-1}$ to $1*10^4$
Iodine vapors (measuring channel)	from 6 to $3*10^4$
Iodine vapors (signal channel)	from $1*10^2$ to $3*10^5$
Noble gas (Ar-41)	from $2.5*10^5$ to $5*10^9$
Noble gas (Kr-85)	from $2.5*10^5$ to $5*10^9$
Noble gas (Xe-133)	from $5*10^5$ to $1*10^{10}$

All measurement channels of RKS-3 relay visual and acoustic alarm signals into the Radiation Safety Control Room. Alarm values are pre-set for warning and emergency levels (Bq/m³):

Monitored item	Channel	Warning	Emergency
Short-lived aerosols ($T_{1/2}$ <24 hours), high sensitivity	0	740	$3.70*10^3$
Short-lived aerosols ($T_{1/2}$ <24 hours), low sensitivity	1	3700	$3.70*10^4$
Noble gas, high sensitivity	2	$2.6*10^5$	$7.4*10^6$
Noble gas, low sensitivity	3	$5.6*10^6$	$2.8*10^7$
Long-lived aerosols ($T_{1/2}$ >24 hours), high sensitivity	4	14.8	74
Long-lived aerosols ($T_{1/2}$ >24 hours), low sensitivity	5	55.5	275.5
Iodine isotopes, high sensitivity	6	55.5	275.5
Iodine isotopes, low sensitivity	7	555	2755

5.3.2 Building 150 (water treatment plant)

Continuous on-line monitoring of noble gas, aerosols and iodine total activities is implemented through a RKS-3 system, similar to the one described above.

5.4 Effluent laboratory

The effluent laboratory is responsible for the analysis of all the samples taken by the RKS-7 and RKS-3 systems: noble gas, aerosol and iodine samples. The statutory programme for sampling and analysis of airborne discharges is given in Appendix 6.

5.5 Independent regulatory control by VATESI

The on-site VATESI representative requires the INPP to daily transmit its discharge data for verification against regulatory limits.

VATESI does not validate discharge data through an independent check monitoring and/or sampling and analysis programme. However, VATESI satisfies itself of the efficiency of the discharge monitoring and sampling systems as well as the validity of the results generated:

- Through validation of the operator's monitoring and sampling programme (including operating procedures).
- By qualitative control (follow-up) of the operator's monitoring and sampling equipment (including related operating procedures, maintenance reports and calibration results).

On an annual basis the discharge data communicated by the operator are checked for consistency. A trend analysis is also performed.

6 VERIFICATION ACTIVITIES - RADIOACTIVE DISCHARGES

6.1 Airborne discharges

6.1.1 Verification activities

The verification team visited:

- The rooms in which the various monitoring and sampling devices are located (Unit-2 and building 150). The team verified the existence and functionality of all the monitoring and sampling provisions as defined in the regulatory obligations.
- The Radiation Safety Control Room (RSCR) where the team observed the systems and provisions available for discharge control.
- The Effluent Laboratory where the team verified the adequacy of the analytical systems in place, including various aspects of quality assurance and control (working instructions, methodologies, calibration, maintenance, bookkeeping of results, reporting etc.).

6.1.2 Verification findings

6.1.2.1 <u>The monitoring and sampling devices for airborne discharges</u>

The verification team confirmed the existence and functionality of all the monitoring and sampling provisions as described in section 5 above.

The verification team noted:

(1) The operator provided the team with the relevant technical drawings of the various sampling lines to demonstrate the configuration of the sampling nozzles within the stack and to further explain the isokinetic chatacteristics of the sampling lines. To avoid condensation the sampling lines are protected by isothermic mantles.

(2) Radiometric facility RKS-7 was operating and continuously measuring the activity concentrations of noble gases, particulates and iodines. The team noted that the labelling of various plant items belonging to the sampling chains could be improved. Linking plant items to technical drawings could not always easily be established. This leaves room for quality assurance improvements.

(3) The RKS-3 radiometric facilities (Unit-2 and building 150) were operating and continuously measuring the activity concentrations of noble gases, particulates and iodines. It is noted that for Unit-2, RKS-3 acts as back-up to RKS-7 since 1992.

(4) Despite the provisions laid down in LAND 42-2001, the team noted the absence of provisions for the assessment of both H-3 and C-14 (the later being a major dose contributor) in airborne discharges.

(5) The INPP Metrology Departement is responsible for the calibration and maintenance of all the monitoring and sampling devices. Calibration is performed once a year, calibration tests by built-in sources weekly, maintenance every quarter. Functionality checks are carried out every shift. Upon request the operator submitted the three calibration certificates for the components of RKS-7, as well as the technical documentation of the whole system. Furthermore the team was allowed to consult a set of maintenance reports. Both calibration certificates and maintenance reports were unambiguously linked to the devices in question (plant item identifiers) and duly signed by the whole chain of custody.

(6) The connection between sampling lines and sampling devices for RKS-3 is made with sections of transparent waterhose. These sections are of considerable length (up to more than one metre) and bending radiuses are not controlled. Depositions of dirt were clearly visible within these connectors, despite the presence of HEPA filters upstream of the vent stacks. These depositions were of various kinds: not only adsorbed on the hoses' inner walls but also as loose particulate accretions. Consequently the verification team must question the representativeness of the samples collected.

With respect to (2):

> *It is suggested that the competent regulatory authority requests the operator, in the framework of general quality assurance and control, to improve the plant item labelling system for RKS-7 and RKS-3 so as to ensure unambiguous identification of the various components of the monitoring and sampling chains.*

With respect to (4):

> *It is suggested that the competent regulatory authority enforces the provisions for airborne discharge assessment for H-3 and C-14 as laid down in LAND 42-2001.*

With respect to (6):

> *It is suggested that the competent regulatory authority investigate the current design of the connectors between sampling lines and sampling devices to establish whether the representativeness of samples taken for the assessment of radioactive discharges is guaranteed.*

6.1.2.2 The Radiation Safety Control Room

The verification team visited the RSCR were the on-line monitoring and control systems were demonstrated.

The verification team noted:

(1) The RKS-7 system was operational: real-time and time integrated activity (1hr and 24 hr) values were displayed and noted down by the team.

(2) The RKS-3 system, although fitted with functional, warning and emergency alarms (LEDs of various colors), did not display the actual activity values. Upon enquiry the operator told the team that RKS-3, as back-up system, only stores the real-time and time integrated values, and that these can be downloaded and consulted whenever necessary.

(3) All systems are covered by the INPP uninterruptible power supply.

(4) The verification team also visited the future RSCR room that is planned to become operational by the end of the year 2005. The new RSCR will be equipped with up-to-date hardware and software to cope with the overall modernization and upgrading of the various monitoring and detection systems. Putting the new RSCR into operation is one of the conditions set by VATESI for the renewal of the INPP license to operate.

With respect to (4):

> *The verification team endorses the efforts to modernise the various on-line radiological monitoring and alarming systems.*

6.1.2.3 The Effluent Laboratory

The verification team noted that:

(1) The laboratory is sufficiently equipped for fulfilling its regulatory obligations.

(2) A quality assurance and control programme is in place and implemented through a compilation of comprehensive written working instructions and source documents. Operating manuals are available for every type of equipment. The team could easily access maintenance reports and calibration certificates.

(3) The chain of custody of sample taking, sample analysis and data handling is well defined (labeling of samples throughout, responsibilities of individuals, bookkeeping). The team performed a vertical audit on randomly choosen historical samples, this exercise could be easily performed and did not reveal any shortcomings.

(4) The laboratory never participated in international intercomparison exercises. However, periodically the Effluent laboratory and the Lithuanian Institute of Physics undertake proficiency tests to compare results on samples of airborne releases from the INPP.

(5) Values below detection limit are booked at the detection limit value.

With respect to (4):

> *It is suggested, in the framework of general quality assurance and control that the competent regulatory authority considers the benefit of requiring that the laboratory participate in intercomparison and/or proficiency tests.*

With respect to (5):

> *It is reminded that the European Commission issued Recommendation 2004/2/Euratom [(3)] wherein substitution rules for values below the detection limit are presented. Such rules are proposed to avoid unnecessary over- or underestimation of discharged activities. These substitution rules are in line with ISO standard 11929-7:2005.*
>
> *It is suggested that the competent regulatory authority consider the benefits of revising its regulatory requirements for substitutions of analytical results below detection limits by bringing these requirements in line with Commission Recommendation 2004/2/Euratom and ISO standard 11929-7:2005.*

6.2 Liquid discharges

The verification team visited the location of the former discharge tanks with the aim to verify the provisions put in place to disable routine discharges of active process waters from INPP (since 1995). To that effect technical drawings were provided against which the team identified plant items and verified the actual layout of the plant.

The team noted that:

(1) The former discharge tanks (plant items TR37B01, 02, 03 and 04) are now used to store the clean water produced by the water treatment plant.

(2) The former discharge valve (plant item TR38S310) was locked out by a chain and padlock.

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(3) Downstream of the valve a section of the discharge pipe was cut away.

(4) Both ends of the discharge pipe were capped.

Note: the operator confirmed that the other former discharge valves, plant items TR38S505, TR38S541 and TR21S001, are locked out in a similar fashion to valve TR38S310.

The verification team could satisfy itself that routine discharges of active process waters from INPP are physically impossible.

At the same time the verification team was briefed on the water treatment procedures and given an overview of the water treatment plant. Sampling procedures for sentencing purposes prior to release of tank contents for re-use were demonstrated.

7 ENVIRONMENTAL MONITORING

7.1 The National Environmental Monitoring Programme

7.1.1 Introduction

The national environmental monitoring programme (radiological surveillance) in Lithuania covers the whole of the national territory and puts special emphasis on the area around the Ignalina NPP, the so called sanitary protection zone. The programme is valid for 3-5 years, e.g. 1999-2004 and 2005-2010.

The programme is prepared in accordance with National and EU regulations (Euratom Treaty and EC Recommendation 2000/473/EURATOM on the application of Article 36 of the Euratom Treaty) and international Conventions. In this context, the Ministry of the Environment and the Ministry of Health have issued Order nr.538/490 (7 October 2002), which regulates the organisation and implementation of the national radiological monitoring programme and defines reporting obligations. The Order came into force on 1 January 2003.

7.1.2 Distribution of tasks and responsibilities

The two organisations that are in charge of the implementation of the monitoring programme are:

- The Environmental Protection Agency (EPA) of the Ministry of the Environment performs sampling and measurements of airborne particulates, fallout, surface waters and sediments; EPA also monitors ambient gamma dose rate with an on-line network of measurement stations.
- The Radiation Protection Centre (RPC) of the Ministry of Health collects and analyses drinking water, milk, and mixed diet; RPC also performs ambient gamma dose measurements with TLDs. Samples of soil, mushrooms are also analysed.
- The laboratory of the National Veterinary Service also participates in the monitoring programme by measuring raw foodstuffs and feedingstuffs.

Research organisations like the Institute of Physics (IoPh) and the Marine Research Centre (MRC) take part in the monitoring upon demand. MRC participates in water sampling in the Baltic Sea and Curonian Lagoon.

The EPA is responsible for the annual submission of radioecological data (including those collected by RPC) to the EC Article 36 database. The monitoring results for 2002 and 2003 (before the Lithuanian EU accession) were also forwarded to the EC.

7.2 Monitoring programme - activities of the Ignalina NPP

7.2.1 Introduction

The INPP carries out radiological monitoring that consists of both radioactive releases monitoring (source term) and monitoring of levels of radioactivity in the environment (impact assessment) and has well-defined responsibilities as to the implementation of the radiological surveillance on the INPP site as well as in the sanitary protection zone around the site. Monitoring, sampling and analysis activities are conducted within a radius of 30 km around the INPP site, in compliance with the statutory environmental monitoring and sampling schedule and in accordance with the INPP internal quality assurance standards.

According to normative document LAND 42-2001 the implementation of this statutory obligation will be verified by the competent Lithuanian regulatory body that is the Ministry of the Environment (through EPA). The INPP programme includes descriptions of the methodologies that apply to the sampling of air, water and other environmental indicators and imposes detection limits for each kind of sample. The INPP programme also includes the duty to collect relevant meteorological information.

7.2.2 The INPP site-related Environmental Monitoring Programme

Basically, and apart from radioactive discharges monitoring (see section 5 above), the programme consists of (see also Appendices 7 to 10):

7.2.2.1 Air sampling

There is one high volume air sampling station situated on the INPP site and eight stations between 1.6 and 38.5 km distance from site.

7.2.2.2 Precipitation sampling

Atmospheric precipitations (wet and dry deposition) are sampled using stainless cuvettes (50x50x15 cm) situated on the roofs of the air sampling stations. Additionally, 10 cylindrical cuvettes of 80 cm diameter are distributed over the INPP site.

7.2.2.3 Water sampling

Samples are taken from surface waters (Lake Drūkšiai), local drinking water, domestic sewage waters, and the inbound and outbound legs of the cooling water channel.

To monitor ground water there are 50 boreholes of 10-30 m depth inside the plant perimeter and 19 on the adjacent the Spent Fuel Storage Facility site.

7.2.2.4 Other sampling

For media such as milk, biota (fish from Lake Drūkšiai), algae, grass, mushrooms, soil, sludges, sediments, see Appendix 10.

7.2.2.5 Environmental TLD measurementsThe environmental TLD measurement programme consists of 30 TLD locations around the INPP site. The dosimeters are measured twice a year at the Personnel Dosimetry Laboratory of the INPP.

7.2.2.6 On-line monitoring systems

On-line continuous environmental monitoring is carried out by the following systems:

- The SkyLink system (operated by the INPP): a network of 22 GammaTracer probes and their data collection system. The system can automatically accelerate the dose rate monitoring cycle in the event of an emergency. Data are transmitted (radio link) to the Environmental Protection Laboratory and to INPP Radiation Safety Control Room.
- Meteorological conditions in the INPP zone and surroundings are monitored continuously at the INPP meteorological tower, located at 5.5 km distance to the North-West of the site.

7.2.3 The INPP Environmental Laboratory

The Environmental Monitoring Programme of INPP is carried out by the Ecological Safety Service's Environmental Protection Laboratory (part of the INPP Radiation Protection Department). The laboratory is situated at the periphery of Visaginas at approximately 5 km NW from the INPP.

Monitoring, sampling and analysis activities are conducted within a radius of 30 km around the INPP site, in compliance with the statutory environmental monitoring and sampling schedule (see Appendix 10) and in accordance with the INPP internal quality assurance standards.

The laboratory handles some 2500 samples per year and produces monthly result reports for the regulatory authorities.

The INPP is responsible for submitting a consolidated annual report to the Ministry of the Environment (via EPA), to the Ministry of Health (via RPC), to VATESI and to the Local Authorities (Municipal Institutions).

Any modification to the statutory environmental monitoring/sampling schedule can only be made with a formal agreement of the Ministry of the Environment.

7.3 Monitoring programme - activities of the Environmental Protection Agency (EPA)

Two divisions in the EPA are responsible for radiological surveillance:

- The Radiology Division Laboratory, which performs sampling, measurements and analyses.
- The Automatic Measurement Systems Division (RADIS) which maintains the automatic gamma-monitoring network and the mobile radiological laboratory.

The EPA sampling and monitoring programme consists of the following elements:

- At national level, measurements of radioactivity in:

  i. precipitation (dry and wet deposition in 5 locations)
  ii. aerosols (one JL-900 sampler located at Utena, 60 km away from the INPP)
  iii. surface water and sediments from lakes (6 locations) and rivers (9 locations)
  iv. surface water and sediments from the Baltic sea and the Curonian Lagoon (3 locations)

  See also Appendix 11.

- An Automated Environmental Monitoring System (network) which consists of various types of dose rate measurement stations which also monitor some weather parameters. These stations are on-line and the information is transferred to the INPP Radiation Safety Control Room and to the RADIS server at the EPA premises in Vilnius. From there the information is dispatched to the Ministry of the Environment, VATESI, the RPC and the Civil Defence Department of the Minstry of the Interior.

The types of automatic monitoring stations are (see also Appendix 12):

Station type	Origin	Units	Location	Detector type	Measurements type
PMS (Permanent Monitoring Station)	Denmark	9	4 around the INPP and 5 within the country	NaI, GM	Gamma dose rate, spectrum, temperature, rain intensity
AAM-95	Finland	2	Around the INPP	GM	Gamma dose rate
AGIR	Lithuania	9	National Hydrometeorological Institute services	NaI	Gamma dose rate
Mobile (GPS)	Canada Denmark	1 1		NaI	Gamma dose rate, spectrum, geographical coordinates

The alarm threshold for gamma dose rate in Lithuania is set at 300 nSv/h. If this threshold is reached at any measurement location, it will automatically be reported to the central server. All data collected are electronically archived.

The Automated Environmental Monitoring System is linked into the Danish Emergency Management Agency database (ARGOS network - bilateral data exchange and co-operation agreement).

7.4 Monitoring programme - activities of the Radiation Protection Centre (RPC)

The RPC is located in Vilnius and carries out laboratory measurements. There are also 4 regional departments of the RPC which collect environmental monitoring samples in their respective regions. The staff of the RPC consists of 50 people, 15 of them belong to the department accredited for measurements.

It is accredited by the Lithuanian National Accreditation Bureau according to ISO 17025 requirements (accreditation number LA.01.065, valid till 3 February 2010) and participates in national and international intercomparison exercises.

The RPC sampling and monitoring programme (the requirements of which are defined in document V-312, approved by the Ministry of Health on 3 May 2004) consists of the following elements:

- Sampling and measurements of radioactivity in:
  - i. drinking water (8 locations - app. 150 samples/year)
  - ii. local food products (7 locations - app. 100 samples/year)
  - iii. mixed diet (1 collecting point, at Vilnius - 12 samples/year)
  - iv. milk (8 locations - app. 40 samples/year)

  Furthermore special attention is paid to the radiological monitoring of mushrooms (app. 400 measurements a year) and wild berries. At the locations where these are sampled, the RPC also takes samples of soil and mosses.
- Measurement of ambient gamma dose with TLDs in the regions of Ignalina and Kupiškis.
- One station for the collection of wet and dry deposition (at Vilnius).

More details are given in Appendix 13.

8 VERIFICATION ACTIVITIES - ENVIRONMENTAL MONITORING

8.1 Introduction

The verification team visited:

- The Environment Protection Laboratory of the INPP (Visaginas) and several monitoring installations in the 30 km zone around the INPP.
- The Environmental Protection Agency Laboratory of Ministry of the Environment (Vilnius).
- The Radiation Protection Centre of the Ministry of Health (Vilnius).

8.2 Verification activities at the Ignalina NPP Environmental Monitoring Laboratory

8.2.1 Introduction

The INPP laboratory is in charge of monitoring activities of air, water and soil on site and in the area around the site. In addition, the laboratory takes care of meteorological systems and dose rate monitoring systems for routine and emergency situations. The laboratory is not accredited but aims at complying with ISO standards. Laboratory staff is cross-trained to carry out several measurement types. It is also possible to exchange staff between the environmental laboratory and the plant discharge laboratory.

> *It is suggested that the laboratory seeks accreditation under ISO 17025.*

The verification team was told about a probable future reduction (app. by half) of the number of environmental samples taken within the 30 km sanitary protection zone.

> *It is suggested that the competent regulatory authority ensures that such a reduction of the site-related environmental monitoring programme does not negatively affect the adequacy and representativeness of the programme.*

8.2.2 Air sampling stations

Air sampling is done by several high volume air samplers located around the site area and surroundings. The samplers are installed in large locked metal containers. They have a large filter cloth (type FPP-15 double layer) but no active charcoal filters. Filter cloth is changed every ten days. Sampling accuracy is limited, since there is no direct measurement of the airflow through the filter cloth. An indication of the flow is calculated by recording the number of kWh's consumed by the pump motor during the sampling period. There is no electrical back up system for the samplers.

The team visited high volume air samplers on site area, Tilze village, Turmantas and Visaginas (laboratory). The station at Tilze was temporarily shut down and therefore air sampler measurements were not available. As the Tilze station also houses other monitoring devices, this resulted also in the absence of information on gamma dose rate, gamma spectrum, temperature and rain intensity. The other stations were found to be functional. The laboratory staff demonstrated filter change procedure at Turmantas.

> *It is suggested that the laboratory considers installing flowmeters on the air sampling devices with the aim to improve the accuracy of the data obtained. It is also suggested that the continuous operation of the sampling devices be ensured through the installation of electrical back up systems.*

8.2.3 Precipitation sampling

There are two different types of precipitation sampling devices in use:

8.2.3.1 Collecting rainwater in a dish

Precipitation sampling is done by collecting rainwater in a dish with a height of 10 cm and subsequent measurement of the liquid sample in the laboratory. The sampling rate is once a month. This method provides an indication of combined wet and dry deposition, but is inaccurate with respect to wet deposition due to evaporation.

8.2.3.2 Filtering rainwater through a filter cloth

Precipitation sampling is done by placing a filter cloth on a vertical pipe in order to collect dry deposition (i.e. rainwater itself is not collected); the deposition on the filter cloth is measured in the laboratory. The sampling cloth is replaced once a month. This method provides an indication of combined wet and dry deposition only. The system is not intended to be operational during wintertime since snow is not passing through the filter cloth. The team was however informed that separate snow samples are taken during winter.

The team visited precipitation sampling station numbers 7 and 11, located on site. Access to the sampling locations was not restricted and there was no identification labels on the sampling system.

> *It is suggested that the laboratory sets up a system that effectively collects rainwater and to measure the activity contents as with any other water sample. In addition, the team suggests clearly labelling all sampling systems and restricting access to the sampling sites.*

8.2.4 Groundwater sampling

Groundwater sampling is carried out on several boreholes on the site area. The team visited borehole number 29539 between buildings 150 and 130 of the INPP site. The team observed that the borehole cover was not locked.

> *It is suggested to restrict access to all sampling locations, even to those located inside the site perimeter.*

8.2.5 Water sampling from plant inlet and outlet channels

Water sampling is done by filling a 10-litre canister from the plant inlet and outlet channels. In addition, a separate small sample is taken for tritium measurement. There is no automatic sampling system, which could alert on possible accidental releases. The team witnessed sample taking from the inlet channel.

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

8.2.6 Sediment sampling

Sediment sampling on Lake Drūkšiai is carried out on regular basis. Sampling depth is some 15-20 centimetres. The team verified the sediment sampling equipment (Danish origin) at the laboratory.

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

8.2.7 Soil and grass sampling

Soil and grass samples are collected by the plant laboratory once a year in May-October close to each high volume air sampling station. Sampling locations are not identified and there are no access restrictions to them.

Verification does not give rise to particular remarks.

8.2.8 Foodstuffs sampling

Milk and meat sampling around the INPP area is carried out, but not on a regular basis. Disruptions in the continuity of the sampling programme are due to lack of funds to purchase the samples from local producers. Fish samples, however, are regularly collected from Lake Drūkšiai in accordance with the programme.

It is suggested that such budgetary means are provided that are necessary to maintain an adequate number of milk and meat samples so as to ensure a representative coverage of these media.

8.2.9 Skylink system - GammaTracer stations

The Skylink system receives dose and dose rate data from the 24 GammaTracer units (Genitron) located at site and the INPP surroundings. The system has been operational since 2002. It used to have 24h surveillance. Data is transferred automatically to plant radiation protection unit. The system has a UPS and battery back up. The team verified the availability of two stations on the plant fence and one in the Turmantas railway station.

Verification does not give rise to particular remarks.

8.2.10 Other monitoring equipment - meteorology

There is a 40-metre meteorological tower located next to the laboratory building some 5 kilometres from the INPP. It is equipped with wind speed and direction, temperature, insolation, dose rate and humidity sensors, as well as two independent meteo systems. The sensors are situated at 2, 30, 35 and 40 m above ground. The tower has electrical back up. The team visited the tower and the emergency monitoring station located next to it. This emergency station measures wind speed and direction, temperature, humidity, air pressure, insolation, precipitation and dose rate. In case of emergency it automatically measures total alpha, total beta of aerosol and iodine activity of sampled air. It has electrical back up.

Verification does not give rise to particular remarks.

8.2.11 Sample preparation room

The sample preparation room is equipped with an evaporator and a furnace. A handwritten sample preparation log is kept in the room. Therein sample details are duly recorded on individual sample forms (type of sample, place and date of sampling, sampling period, sample quantity etc.). Entries must be signed by the laboratory assistant receiving the sample. There is no database for incoming samples, but the team was informed that such a database is in preparation.

When taking a water sample, the sampling location is identified on the label of the sampling bottle. The date of sampling is however not recorded on this label but on the accompanying sampling form.

The team supports the efforts to create an electronic database for incoming samples.

8.2.12 Scales

Laboratory scales have calibration logs and standards available. In addition, temperature and humidity are recorded on each calibration, in line with EPA requirements.

Verification does not give rise to particular remarks.

8.2.13 Sample storage

According to the laboratory practice, all samples are stored until the end of the year, or until the relevant report is done. There are no formal requirements for the storage time.

<u>It is suggested</u> that the competent regulatory authority defines storage periods for each sample type.

8.2.14 Beta counter

The laboratory is equipped with a Beta Multicounter GM-25-5 (anticoincidence system), which is able to count five samples at a time, counting time being 12 or 24 hours. Results are imported to spreadsheets; there is no specific database for storing the results.

Verification does not give rise to particular remarks. The verification team would welcome the development of a central laboratory database for storing measurement results.

8.2.15 Gamma spectroscopy

The laboratory has four Canberra germanium semiconductor detectors (30-35 % relative efficiency). In addition, there are two portable germanium detectors (one manufactured by Eurisys and other by Baltic Scientific Instruments, Latvia). System calibration is performed annually by the Russian calibration institute. Calibration sources originate from Russia. Source activity certificates were presented to the team. Calibration sources storage room is locked and the entrance is restricted.

There is an electrical back up system for the gamma spectroscopy systems, which assures 4 hours of autonomy. The laboratory does not have air conditioning, but temperature and humidity are regularly monitored.

The team noted that the laboratory performs regular (daily) calibration controls on the spectroscopy systems in order to identify possible instability of the systems. However, the procedure only addresses the efficiency (cps) and location (keV) of the cobalt peaks. The peak width control (FWHM) is not included in this procedure.

The team witnessed a demonstration of the estimation of the radionuclides on an air sample using one of the Canberra gamma spectrometry systems.

<u>It is suggested</u> that the calibration control procedure be improved by not only checking the efficiency (cps) and location (keV) of the Cobalt peaks in standard geometry, but also by including a peak width check (FWHM).

At the same time <u>it is suggested</u> that such a system stability control procedure be performed on a weekly basis in order to allow for an early identification of any detector degradation.

8.2.16 Alpha spectroscopy

The laboratory performs alpha spectroscopy using an Ortec Octete Plus alpha spectroscopy system (8 sample chambers) and with a total alpha/beta counting system UMF-2000 of Russian provenience (automatic calibration).

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

8.2.17 Liquid scintillation counter

The laboratory has a liquid scintillation counter Packard Tri-Carb 2770TR/SL, which is in use for tritium measurements since 1998. Before 1998 Tritium was not measured at Ignalina. Measurement results are stored on spreadsheets.

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

8.2.18 Data storage

Measurement data is stored indefinitely on paper and on PC hard disk (word processor, spreadsheet or a computer-based data storage application). In a number of cases the results are recorded twice on two different systems. The risk to unwittingly introduce clerical errors is clearly present. The member of staff transferring the data is not registered in the system. There is a plan to establish a data back up system on the network server.

> *Verification does not give rise to particular remarks. The team supports the plan to improve data storage and back up arrangements.*

8.2.19 Intercomparisons

The laboratory has participated in an intercomparison exercise organised by the Risø National Laboratory (Denmark). A report was made available to the verification team.

> *As a matter of good laboratory practice, <u>it is suggested</u> that the laboratory continues to participate in intercomparison exercises.*

8.3 Verification activities at the Environmental Protection Agency (EPA)

8.3.1 Introduction

The EPA laboratory annually analyses some 600 samples collected from various Lithuanian sampling locations for water, sediments, fallout, aerosols and soil. The radiological sector of the laboratory is not accredited, but it aims to comply with ISO standards. Quality manuals (ISO/IEC 17025) were made available to the verification team. The laboratory has a staff of 4 persons.

The team verified at the EPA Radiology Division Laboratory in Vilnius the adequacy of the analytical systems in place, sampling procedures and traceability, including various aspects of quality assurance and control (working instructions, methodologies, calibration, maintenance, bookkeeping of results, reporting, etc).

> *The team supports the laboratory practice of trying to comply with ISO standards and encourages further work towards accreditation.*

8.3.2 PMS system

There are nine PMS-stations in the Lithuania area (the PMS system belongs to EPA), four of them in the Ignalina area. These stations monitor dose rate (GM-tube) and produce a NaI-spectrum. In addition, there are temperature and precipitation measurements (dripping-bucket system, not heated). Measurements are made in 10-minute periods, averaged over one hour. Data is transferred to Vilnius central data collection automatically every 24 hours. In case the dose rate exceeds 300 nSv/h, the station calls Vilnius for immediate data transfer and alert. There is battery back up for three days operation without external power.

The team verified the functionality of the PMS measurements system located at roof of the INPP laboratory building.

Verification does not give rise to particular remarks.

8.3.3 Water sampling

Water sampling consists of lake-, river- and seawater sampling; the EPA laboratory does not perform measurements on drinking water nor groundwater samples.

The deep layer water sampler used for the marine water sampling was demonstrated. For Cs-137 analysis 100-200 litres of water is filtered through a filter cartridge and the filter is transported to the laboratory. For Sr-90 analysis, a 60 litre sample is delivered to the laboratory for radiochemical separation.

Samples of surface water from lakes and rivers (50-60 litres) are delivered to the laboratory by the Regional Departments of the Ministry of Environment or by the Expedition Division of the EPA.

Verification does not give rise to particular remarks.

8.3.4 Aerosol sampling

The laboratory performs measurements of the filter paper samples received from the medium volume (150 m^3/h) air sampler in Utena (a JL-900 'Snow White'). This station has both glass fibre filter and an activated carbon cartridge. The filter paper is changed twice a week.

Verification does not give rise to particular remarks.

8.3.5 Sediment and soil sampling

Sediment and soil sampling devices were presented to the team. The Danish Risø Laboratory has manufactured the laboratory sediment collector.

Verification does not give rise to particular remarks.

8.3.6 Receipt of samples

The sample receipt log is kept on paper; there is no central database in the laboratory. There are two furnaces for drying and ashing of samples present in the preparation room.

Filter paper samples are received via mail.

For water samples, the labels on the sample bottles indicate the sampling location. Upon return to the sample preparation room, the information that is written on the accompanying sample form is copied on the sample receipt log. A sample identifier (number) is then taken from the log and written on the sample bottle, before further processing. The verification team, although acknowledging that this procedure is adequate for routine operations, believes it not to be robust enough in the event of drastically increased sample numbers (i.e. emergency situation).

> *It is suggested, in the context of general quality assurance and control that the laboratory reviews its sample identification and receipt procedures with a view to ensure enough robustness of the system, especially for situations where the number of incoming samples could increase.*

8.3.7 Gamma spectroscopy

The laboratory has an Oxford Germanium semiconductor detector (20% relative efficiency) with Tennelec measurement electronics for gamma spectroscopy measurements in the laboratory, and one portable Canberra Gamma spectroscopy system for use in the field (customs inspections etc.). Detector efficiency certificates were not found and could therefore not be verified.

Counting times are 24 hours for aerosol samples and 60 hours for water samples. Long counting times severely limit the number of samples counted in the laboratory. Background measurements (20 hours) are performed monthly.

Gamma spectroscopy system maintenance is performed once a year with a standard source. Calibration checks are done four times per year. Certificates of the standard sources used were made available to the verification team. Calibration checks do not include detector stability or resolution control.

The laboratory possesses an Amersham liquid standard, which is used to prepare liquid calibration standards for specific geometries.

> *It is suggested that a Co-60 calibration source be made available for the lab in order to establish a weekly control programme for the efficiency (cps), location (kEV) and width (FWHM) of the cobalt peaks in standard geometry. This would allow for a regular control of system stability and early identification of any detector degradation.*

8.3.8 Alpha spectroscopy

The laboratory has an alpha spectroscopy system Tennelec TC256. The laboratory has also one alpha/beta counting system TESLA for low activities.

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

8.3.9 Beta counter

Laboratory has an obsolete Russian RUB-01P single chamber beta counter. The device is functional, but lacks the necessary capacity for adequate beta measurement capability.

> *It is suggested that the laboratory beta counting capacity be increased to an adequate level.*

8.3.10 Intercomparisons

EPA laboratory has participated in an intercomparison exercise organised by the Risø National Laboratory (Denmark). A report was made available to the verification team.

> *As a matter of good laboratory practice, it is suggested that the laboratory continue participation in intercomparison exercises.*

8.4 Verification activities at the Radiation Protection Centre (RPC)

8.4.1 Introduction

The RPC, through its Department of Programs of Expertise, is in charge of foodstuff radioactivity measurements in Lithuania. The unit also provides TLD dosimetry reading and full-body counting services for radiation workers in Lithuania and is able to carry out also radon and other types of radiological analysis. The unit is accredited to ISO 17025. It has a staff of 50.

RPC carries out independent foodstuffs and drinking water sampling at the surroundings of the Ignalina site and is therefore in position to verify results of the plant measurement programme.

The team verified the adequacy of the analytical systems in place, including various aspects of quality assurance and control (working instructions, methodologies, calibration, maintenance, bookkeeping of results, reporting, etc).

8.4.2 Sample receipt

Samples are received on 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.*

8.4.3 Sample preparation room

Sample preparation room has two drying ovens, 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.

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

8.4.4 Chemical separation room

Chemical separation room has the necessary equipment for Sr-90, Tritium and radon chemical separations. Every step of the process has its own work instruction.

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

8.4.5 TLD reader room

The laboratory has two RADOS TLD readers and one TLD irradiation device. TLD's are used for both personnel and environmental dose measurement purposes. Some 11 000 TLD's are read annually for occupational dose and some 200 for environmental dose. The environmental TLD measurement programme consists of 16 TLD locations around the INPP area, 5 locations in main towns and 16 locations in another area, which is considered a clean reference area. TLD's are irradiated for 6 months at the time.

TLD readers are calibrated annually by a secondary standard lab in Riga, Latvia. Intercomparison exercises are organised among similar laboratories in the Baltic States.

Verification does not give rise to particular remarks.

8.4.6 Gamma spectroscopy room

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%, 26,3% and 50%.

Gamma spectroscopy system efficiency calibrations are done using standard calibration sources for all measurement geometries. Standards are kept in a separate locked storage room. Standard source certificates were made available to the verification team. Calibration control is done once a week. The control includes peak efficiency (cps), gamma energy (keV) and width (FWHM) controls.

Laboratory liquid nitrogen supply is done by fetching 80 litres of liquid nitrogen by the laboratory car from a local supplier. According to the information given this supplier is the only available commercial source in Lithuania. The closest back-up options are the INPP and a company in Poland.

<u>It is suggested</u> that the RPC considers ensuring that liquid nitrogen supply can be done from multiple sources in order to avoid supply disruption for example in emergency situations.

8.4.7 Alpha/beta counting room

Total-alpha and total-beta measurements are done using two Canberra IN20 Alpha-beta multidetector systems. Sr-90 counting is done with a Quantulus 1220 Ultra low-level liquid scintillation spectrometer or with Tri-Carb TR/SL 2770 liquid scintillation counter. 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.

8.4.8 Emergency arrangements

In the event of a radiological emergency, the laboratory is prepared to make additional arrangements for receiving, washing and storing large amounts of samples. There are also plans to facilitate measurements of high-activity samples in emergency situations.

Verification does not give rise to particular remarks.

8.4.9 Sample storage

There is no legal requirement for storing samples and the room allocated for this purpose is small. The laboratory practice is that a sample is kept if its measurement results indicate an activity close to a decision level.

> *It is suggested that the laboratory defines a comprehensive set of criteria applicable to sample storage.*

8.4.10 Document control and quality manuals

The team performed a document control for an old sample measurement. The requested documentation was made available to the team without any problems. In addition, laboratory quality manuals, work procedures and ISO certificates were all available to the verification team.

Paper documents (forms, documentation, etc.) are archived for 75 years in the archive/library room of the laboratory.

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

8.4.11 Staff training

Laboratory staff has been extensively trained outside Lithuania, mostly by the IAEA and the EU. Laboratory maintains a training programme according to ISO 17025. The team verified the staff training records along with the relevant job descriptions.

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

8.4.12 Intercomparison exercises

Laboratory has participated in many intercomparison exercises. The team verified the most recent intercomparison reports.

> *The verification team acknowledges the extent of the intercomparison activity.*

8.4.13 Other remarks

Every device in the laboratory has an individual UPS system, which provides some 30 minutes of interruptible supply. There is no central electrical back up for the whole building. The building has air conditioning.

> *The verification team appreciated the modern and well-maintained equipment base of the laboratory.*

9 FURTHER VERIFICATION FINDINGS

9.1 With respect to independent control of radioactive discharges

The principal responsibilities attributed to VATESI are centered upon safety and security of nuclear installations, as well as licensing of these.

The Ministry of the Environment is in charge of issuing the discharge limitations for radioactive effluents from the INPP.

The regulatory control whether the INPP abides by these limitations is, however, within the remit of VATESI. Indeed, VATESI, through its on-site representative (inspector) requires the INPP to daily transmit its discharge data for verification against regulatory limits. VATESI does however not validate these discharge data through an independent check monitoring and/or sampling and analysis programme [(4)]. VATESI's validation procedure is, as a matter of fact, restricted to the approval, control and follow-up of discharge-related INPP quality assurance documentation: a paper-based supervision without an effective and independent verification of the source term (the radioactive discharges).

This quality assurance documentation subjected to VATESI control encompasses, between others:

- The compulsory discharge monitoring and sampling programme.
- Operating procedures (working instruction) at plant and at laboratory level.
- Analytical methodologies used in the laboratory.
- Calibration results and maintenance reports of monitoring and sampling devices.
- Calibration results and maintenance reports of analytical equipment present in the laboratory.

Currently it is accepted good practice in the European Union that the regulator himself implements a (systematic) sampling and analysis programme on the discharges of radioactive effluents. To that effect the regulators may have their own sampling systems in place or have a co-operation agreement with the operator where the latter provides the samples (under random supervision of an inspector). Analysis of these samples is then done at the regulator's laboratory (or by a contractor) and results obtained are compared with those reported by the operator. This comparison then is the basis for validation of the operator's discharge data.

Furthermore, the regular transmission of the results of the regulator's samples to the operator may provide the latter with a valuable means of performing analytical quality assurance checks.

> *<u>It is suggested</u> that VATESI, in order to fully discharge itself from it responsibilities as a regulator having competence in discharge control, whilst maintaining its current control over aspects of quality assurance and control, puts in place a comprehensive and independent check monitoring programme on the discharges of radioactive effluents from the INPP, in particular with respect to airborne discharges.*

See also section 9.3 below.

9.2 With respect to the EPA and the RPC

Both the Ministries of Health and the Environment have responsibilities in the implementation of the national radiological surveillance, respectively through the RPC (Radiation Protection Centre) and the EPA (Environmental Protection Agency). The EPA is an agency with regulatory duties (participates in the preparation of legal documents, controls the INPP Environmental Monitoring Laboratory, checks the INPP monitoring program and reports) whereas the RPC is a fully fledged regulatory body.

The EPA laboratory is poorly housed and lacks enough space to reasonably accommodate analytical equipment as well as personnel. The equipment used in the EPA is obsolete and mostly lacks back-up systems. This is compounded by the absence of air conditioning as well as uninterruptible power supplies. Additionally, the laboratory has severe staff shortages.

Despite of this precarious situation, the EPA takes part in the national radiological surveillance programme. This participation encompasses the measurement of a range of environmental samples (it

4 The Ministry of the Environment does not implement such a programme either.

is noted that these samples are for a great majority taken by local agents throughout the country, and that these samples are transferred to the EPA via the postal services).

The EPA centralises all data from the national radiological surveillance programme, data that are generated by the RPC and the INPP (sanitary protection zone). The EPA is charge of transmitting part of these data to the EC under the terms of Article 36 of the Euratom Treaty.

Water and sediment samples are taken by Regional Departments of the Ministry of the Environment or the Expedition Division of EPA. Samples of aerosols are taken by the Utena Regional Department and samples of precipitation are taken by personnel of the Meteorological Stations and sent via mail to the laboratory. Marine samples are taken by the Radiological Division of the Marine Research Centre (Ministry of the Environment). Samples in the region of the INPP are taken by the Radiological Division.

It is probable, in view of the above, that the laboratory is not always in a position to correctly carry out its activities. Also, there are no provisions made to facilitate a large number of incoming samples in an emergency situation. Should the number of incoming samples be higher that normal, the laboratory would most likely fail to carry out the measurements altogether.

The Radiation Protection Centre of the Ministry of Health is the main radiation protection regulator in Lithuania. The tasks allocated to RPC, as a regulatory body, encompass nearly all radiation protection related matters, including the protection (and monitoring of the exposure) of workers and the public.

The RPC receives all data from the national radiological surveillance programme, data that are generated by the Ministry of the Environment (through EPA and the National Veterinary Service) and the INPP (sanitary protection zone). Data are used for dose assessment of population.

Finally, it is noted that the RPC runs a state-of-the-art laboratory that has the capacity to take over most - if not all - activities that are currently allocated to the EPA.

> *<u>It is suggested</u> that the competent regulatory authorities, in order to remedy the precarious situation of the EPA, provide the necessary resources for the latter so as to ensure that it can correctly discharge itself from its responsibilities, especially in situations were a significantly increased number of environmental samples must be processed.*

See also section 9.3 below.

9.3 With respect to regulatory bodies in general

In view of sections 9.1 and 9.2 above the verification team believes that the Lithuanian authorities would benefit from a review of the current roles attributed to the actors having regulatory responsibilities in the field of radiation protection. Room is available to more clearly establish and separate roles and activities.

Where it concerns the regulatory control of discharges of radioactive effluents from the INPP, an independent check monitoring programme should be put in place in order to be in line with what is practised by most other Member States of the European Union. Such a programme is generally implemented by the Ministry ruling the discharge limitations (or depending bodies - in this case the EPA). It is therefore questioned whether VATESI is the most effective choice, all the more since VATESI does only perform paper-based verifications, and since VATESI's principal domain of competence lies with matters of nuclear safety and security. However, would VATESI maintain its controlling function over radioactive discharges, it may consider outsourcing the implementation of a check monitoring programme to a third party (for instance to the EPA). Such an outsourcing should in every case be duly formalised with respect to the responsibilities of both parties involved.

The implementation of an independent discharge check monitoring programme in Lithuania will in any case require the provision of additional resources. In this context the verification team takes the point of view that EPA naturally seems the most indicated body for the implementation of a check monitoring programme, be it for its sponsoring Ministry, be it for VATESI.

With respect to the national radiological surveillance there is also room for improvement. A redistribution of tasks between RPC and EPA, whereby RPC would take over those tasks of EPA that are not related to emergency preparedness (i.e. environmental sampling and analysis) should generate scale benefits (optimisation of human and financial resources, less duplication of effort). The verification team takes the point of view that a full scope centralisation of the environmental sampling and analysis part of the national monitoring programme (under routine conditions) within the RPC would create a more efficient surveillance system.

The verification team strongly believes and advocates that putting the above comments into effect will result in a more robust and transparent regulatory structure in Lithuania.

10 CONCLUSIONS

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

The information provided and the outcome of the verification activities 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 around the Ignalina site are adequate. The Commission could verify the operation and efficacy of these facilities.

(2) A number of topical recommendations are formulated. These recommendations aim at improving some aspects of the environmental surveillance around the Ignalina site. The recommendations do not discredit the fact that environmental monitoring around the Ignalina site is in conformity with the provisions laid down under Article 35 of the Euratom Treaty.

(3) The verification findings and ensuing recommendations are compiled in the 'Main Findings' document that is addressed to the Lithuanian competent authorities through the Lithuanian Permanent Representative to the European Union.

(4) The present Technical Report is to be enclosed with the Main Findings.

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APPENDIX 1

VERIFICATION PROGRAMME

Tuesday 22/02

1. Site access formalities
2. Opening meeting: introduction and presentations.
3. The discharge team (Team 1) starts verification activities: stack monitoring and sampling, liquid discharges monitoring and sampling at Unit 2.
4. The environmental team (Team 2) starts verification activities: monitoring and sampling systems and devices put in place in the buffer zone (3 km) and in the sanitary protection zone (30 km).

Wednesday 23/02

5. Team 1 continues verifying monitoring and sampling devices and visits the effluent laboratory.
6. Team 2 continues with operator systems and starts verifying the environmental monitoring put in place by the regulator.

Thursday 24/02

7. Team 1 continues with the effluent laboratory verifications.
8. Team 2 visits the operator’s environmental samples laboratory (AM) at Visaginas, travels to Vilnius, where it visits the RPC laboratory (PM)

Friday 25/02

9. Team 1 travels to Vilnius (AM)
10. Team 2 continue visiting the facilities of the national monitoring network at the RPC (AM)
11. The closing meeting at the RPC premises (PM).

APPENDIX 2

DOCUMENTATION RECEIVED AND CONSULTED

1. Legislation

1. Law on Radiation Protection (Nr VIII-1019, 1999, as amended in 2004)
2. Law on Nuclear Energy (Nr I-1613, 1996, as amended in 2004)
3. Law on the Management of Radioactive Waste (Nr VIII-1190, 1999, as amended in 2004)
4. Law on Environmental Protection (Nr I-2223, 1992, as amended in 2004)
5. Law on Environmental Monitoring (Nr VIII-529, 1997, as amended in 2003)
6. Government Resolution Nr 578 (1998) 'On the Approval of General Regulations for Dosimetric Control in the Case of Radiological Accident'
7. Government Resolution Nr 653 (1999) 'On Regulations for Licensing the Practices Involving Sources of Ionizing Radiation'
8. Government Resolution Nr 651 (1999) 'On the Establishment of the State Register of Radiation Sources and Exposure to Workers and Approval of its Statute'
9. LAND 32-1999 'The procedure of licensing on natural resources usage and restricting on natural resources usage as well as that of setting permissible rates for environmental pollution'
10. LAND 34-2000 'Clearance Levels of Radionuclides, Conditions of Reuse of Materials and Disposal of Waste'
11. LAND 36-2000 'Measurement of Radionuclide content in Environmental Components; Gamma Spectroscopic Analyse of Samples by Spectrometer with Semiconductor Detector'
12. LAND 37-2000 'Measurement of Radionuclide content in Environmental Component; Concentration of Caesium Dissolved in Water Employing Absorbing Filters and Estimation of Water Activity Concentration'
13. LAND 41-2001 'Limitation of Radioactive Discharges from Medical, Industrial, Research and Agriculture Facilities and Order of Issuance of Permits for Discharges'
14. LAND 42-2001 'Limitation of Radioactive Discharges from Nuclear Facilities, on the Permitting of Discharges and on the Radiological Monitoring'
15. HN 52:1999 'Radiation protection and safety in industrial radiography'
16. HN 73:2001 'Basic standards of radiation protection'
17. HN 112:2001 'Requirements for Monitoring of Internal Exposure
18. HN 87:2002 'Radiation protection in nuclear power plants'
19. HN 24:2003 'Requirements of safety and quality of drinking water; quality requirements and monitoring'
20. HN 28:2003 'Requirements for use and supply to market of natural mineral and spring water'
21. HN 85:2003 'Natural Exposure; Standards of radiation Protection'

2. Operational procedures and support documents concerning the Lithuanian Environmental Protection Monitoring Programme

22. Order of the Ministry of Health No. 146 on procedure of the Control of Verification of Compliance with Radiation Protection Requirements
23. Order of the Ministry of Environment and the Ministry of Health No.538/490 of organisation, implementation of radiological monitoring and notification of the state and the autonomous institutions, the European Commission and the public

24. Recommendations for Dosimetry Control in the INPP area; P.Burgasov, M. 1980
25. Methodological Recommendations on Sanitary Control of Radiation Agents in Environmental Objects, Minzdrav, A.Marei, M. 1980
26. ‘Ground Water Monitoring’, methodological recommendations, Lithuanian Geology Service, 1999
27. ‘Ground Water Monitoring of Economy Entities’, methodological recommendations, Lithuanian Geology Service, 2000
28. Methodological Specifications on Wastewater Laboratory Control, Environmental Protection Department, 1993

3. State Nuclear Power Safety Inspectorate (VATESI)

29. Government Resolution N^o 786 on Approval of the state Nuclear Power Safety Inspectorate (VATESI) Statute, 1992
30. General Safety Regulations for Nuclear Power Plants (VD-B-001-0-97)
31. Government resolution N^o 103 on the Approval of regulations for Licensing Activities in Nuclear Energy Field, 1998
32. Government Resolution N^o 1150 on Controls performed by state control institutions
33. General Procedure for Inspections performed by Vatesi (VD-VP-02-2000)

4. Ministry of Environment

34. The Environmental Status in 2003 (*Aplinkos Būklė 2003*), Vilnius 2004
35. Environmental radionuclide levels and the concentration of the radionuclides such as caesium in water solute using sorbent filters and water volume activity assessment, Vilnius 2000
36. Presentation (slides) by the Environmental Protection Agency, titled “The National Environmental Monitoring Programme in Lithuania

5. Ministry of Health

37. The Annual Report 2001 of the Radiation Protection Centre
38. The Annual Report 2002 of the Radiation Protection Centre
39. The Annual Report 2003 of the Radiation Protection Centre
40. Monitoring of radionuclide levels of food and foodstuffs as well as of other products and substances that may determine the population exposure, Vilnius 2000 (*Maisto produktų, jų žaliavų ir kitų produktų, bei medžiagų galinčių įtakoti gyventojų apšvitą, taršos radionuklidais monitoringas*)
41. Requirements for implementation of radiological monitoring of mixed diet, V-312
42. Requirements for monitoring of concentrations of radionuclides in the precipitation and ambient gamma dose equivalent in the Ignalina and Kupiskis districts, V-312

6. Ignalina NPP

43. Radiation Monitoring Schedule, ПТОэд-0515-2
44. Management procedure ‘Environmental Protection’ (QA-2), ПТОэд-0411-1
45. Operational Procedures Preparation Manual, ПТОэд-0208-36
46. INPP Industrial Site Ground Water Monitoring Programme for 2001-2005, ТАСид-0910-69091
47. Environmental Sampling Instruction, Samples Preparation and Radionuclides Concentration and Dose Rate Measurement, ПТОэд-0412-4
48. Instruction on Airborne Releases Into the Atmosphere, ПТОэд-0512-13
49. Set of standards on Methodologies for and Procedures of Radionuclides Measurement in Technological Media, ПТОэд-0528-1

50. Instruction on INPP Departments Cooperation in Environmental Protection area, ПТОэд-0412-2

51. Instruction on Harmful Substances Control in DischargeWater, ПТОэд-0412-3

52. Report on Environmental Radiation Monitoring in INPP region in 2003 , produced by the Radiation Protection Department of the Ignalina NPP (*IAE Regiono 2003 m. Radiacinio Monitoringo Rezultatų Ataskaita*), ПТОот-0545-11

53. The Environmental Monitoring Programme, 2003, produced by the Radiation Protection Department of the Ignalina NPP (*Aplinkos Apsauga – Aplinkos Apsaugos Monitoringo Programa 2003*), ПТОэд-0410-3

7. Other sources

54. Implementation of the Obligations of the Convention on Nuclear Safety in Lithuania – the Third Lithuanian Report in accordance with Art.5 of the Convention, Vilnius 2004

55. An Intercomparison on Radionuclides in Environmental Samples, A Baltic-Danish Project on Radiation Protection 2001-2003, Nielsen S., Risø National Laboratory, Roskilde, Denmark, July 2004

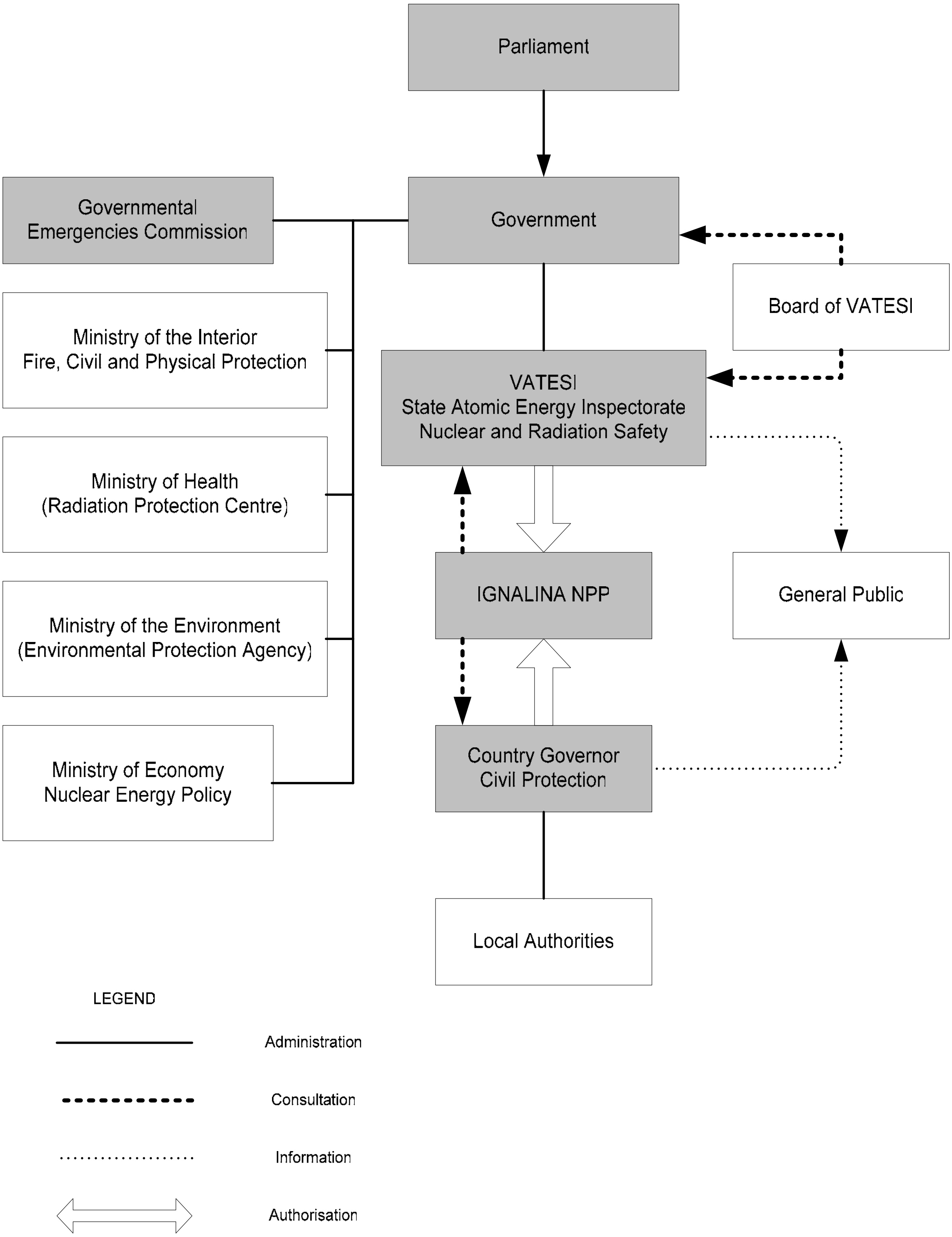
56. Preparation for Ignalina NPP decommissioning, published by LI Kriventa and financed by the Danish Energy Authorities

8. Websites

1.	The Ministry of Economy	www.ukmin.lt
2.	The Ministry of Environment	www.am.lt
3.	The Information Centre of Ignalina NPP	www.iae.lt
4.	The State Nuclear Power Safety Inspectorate (VATESI)	www.vatesi.lt
5.	Radation Protection Centre of Ministry of Health,	www.rsc.lt
6.	Environment Protection Agency of Ministry of Environment,	http://aaa.am.lt
7.	Ministry of Environment, RADIS	http://213.109.47.88
8.	Radioactive Waste Management Agency (RATA)	www.rata.lt

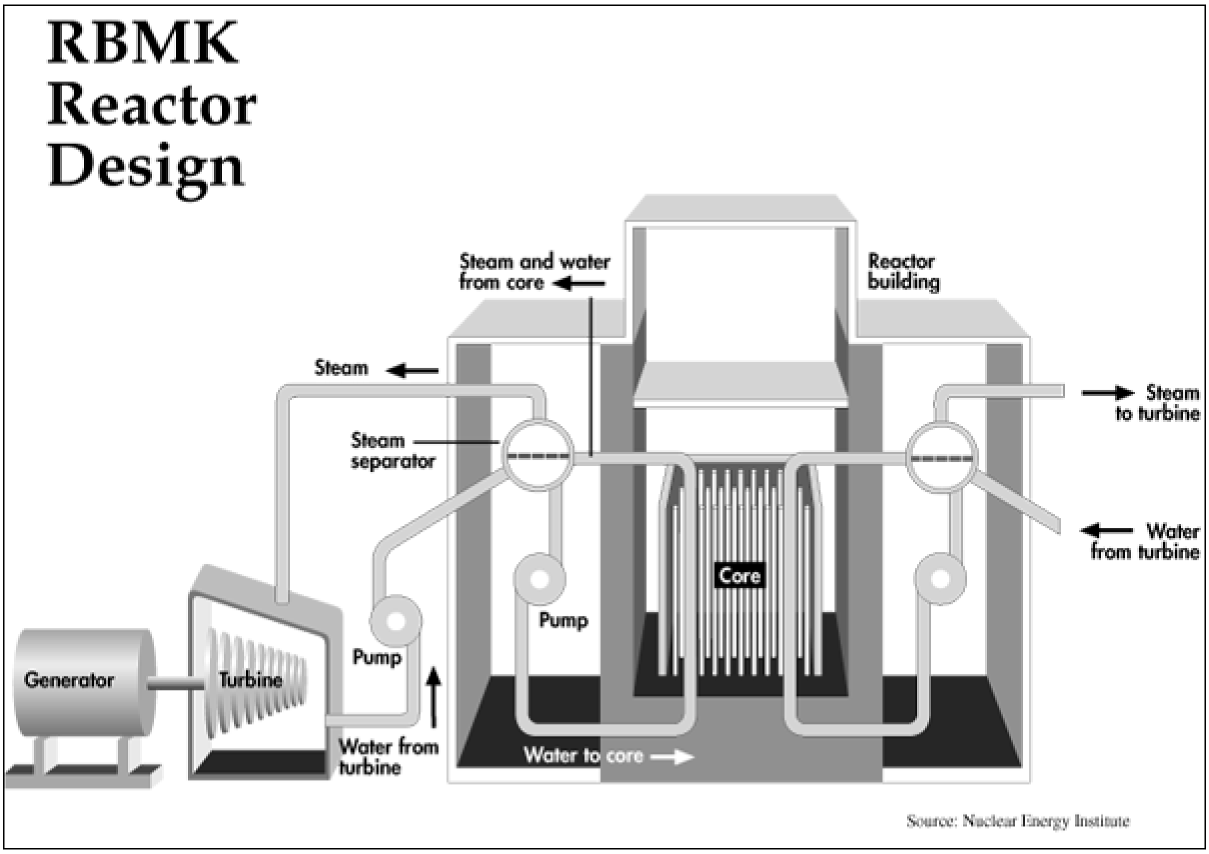
APPENDIX 3

LITHUANIAN AUTHORITIES



APPENDIX 4

IGNALINA NPP – RBMK REACTOR DESIGN



APPENDIX 5

IGNALINA NPP - RADIOACTIVE DISCHARGE LIMITS

1. Airborne discharge limits (in Bq/year)

1.1 Noble gas: nuclide-specific annual discharge limits

Xenon-133	$3.60*10^{15}$
Krypton-85m	$4.50*10^{14}$
Xenon-135	$3.06*10^{14}$
Krypton-88	$1.47*10^{14}$
Krypton-87	$2.15*10^{14}$
Xenon-133m	$2.73*10^{13}$
Argon-41	$9.00*10^{15}$
Xenon-135m	$8.00*10^{13}$
Xenon-138	$6.81*10^{13}$
Total	$1.39*10^{16}$

1.2 Aerosols: nuclide-specific annual discharge limits

Caesium-137	$1.37*10^{11}$	Chromium-51	$6.82*10^{10}$
Niobium-95	$4.87*10^{10}$	Stibium-124	$1.47*10^{10}$
Cobalt-60	$2.88*10^{11}$	Lanthanum-140	$7.72*10^{9}$
Stibium-122	$2.77*10^{9}$	Cobalt-58	$7.34*10^{9}$
Caesium-136	$1.48*10^{9}$	Cerium-144	$7.86*10^{9}$
Caesium-134	$1.33*10^{9}$	Yttrium-92	$5.31*10^{10}$
Zirconium-95	$7.33*10^{10}$	Neptunium-239	$6.59*10^{9}$
Tungsten-187	$5.64*10^{9}$	Zinc-65	$8.32*10^{8}$
Iodine-132	$9.58*10^{8}$	Arsenic-76	$1.03*10^{10}$
Iodine-133	$1.98*10^{9}$	Barium-140	$1.08*10^{9}$
Iodine-135	$8.67*10^{9}$	Strontium-91	$2.59*10^{9}$
Sodium-24	$4.63*10^{7}$	Rubidium-105	$1.25*10^{10}$
Manganese-54	$9.05*10^{10}$	Strontium-89	$6.11*10^{9}$
Iron-59	$4.91*10^{10}$	Strontium-90	$5.38*10^{9}$
Molybdenum-99	$1.46*10^{10}$	Cobalt-58	$7.34*10^{9}$
Manganese-56	$9.62*10^{9}$	Cerium-144	$7.86*10^{9}$
Total $9.40*10^{11}$			

1.3 Additional discharge limitations

IRG (inert radioactive gases) - total	Bq/day	$4.625*10^{13}$
Radioactive aerosols - total	Bq/day	$1.388*10^{9}$
Iodine-131	Bq/day	$9.25*10^{8}$
Strontium-90	Bq/month	$1.388*10^{8}$
Strontium-89	Bq/month	$1.388*10^{9}$
Caesium-137	Bq/month	$1.388*10^{9}$
Cobalt-60	Bq/month	$1.388*10^{9}$
Manganese-54	Bq/month	$1.388*10^{9}$
Chromium-51	Bq/month	$1.388*10^{9}$

2. Liquid discharge limits (in Bq/year)

Caesium-137	$4.836*10^{9}$
Caesium-134	$1.40*10^{7}$
Manganese-54	$3.06*10^{11}$
Cobalt-58	$6.04*10^{10}$
Cobalt-60	$2.996*10^{10}$
Iron-59	$2.08*10^{11}$
Chromium-51	$2.43*10^{13}$
Zirconium-95	$6.74*10^{11}$
Niobium-95	$5.493*10^{9}$
Iodine-131	$9.05*10^{10}$
Strontium-89	$1.66*10^{11}$
Strontium-90	$1.82*10^{9}$
Lanthanum-140	$9.4*10^{8}$
Tritium	$7.78*10^{12}$
Total	$3.358*10^{13}$

APPENDIX 6

INPP AIRBORNE DISCHARGES SAMPLING/ANALYSIS PROGRAMME

1. Reactor building

		Detector	Detection range (Bq/l)	Frequency
Aerosol filters exposition 24 hours	Total beta activity Spectrometry	Geiger-Muller GeLi	$7.4*10^{-6}$ - $1.85*10^{7}$ $5.9*10^{-4}$ - $6.7*10^{5}$	Daily Daily
Aerosol filters exposition 3 days	Total beta activity Spectrometry	Geiger-Muller HP Ge (30%)	$1.9*10^{-6}$ - $1.85*10^{7}$ $1.7*10^{-6}$ - $6.2*10^{4}$	Twice a week Twice a week
Aerosol filters exposition 7 days	Total beta activity Spectrometry	Geiger-Muller HP Ge (30%)	$9.2*10^{-7}$ - $1.85*10^{7}$ $8.0*10^{-7}$ - $6.2*10^{4}$	Weekly Weekly
Aerosol filters exposition 1 month	Total beta activity Spectrometry	Geiger-Muller HP Ge (30%)	$1.9*10^{-7}$ - $1.85*10^{7}$ $8.0*10^{-8}$ - $6.2*10^{4}$	Monthly Monthly
Iodine filters exposition 24 hours	Spectrometry	GeLi	$9.0*10^{-6}$ - $6.2*10^{4}$	Dayly
Iodine filters exposition 3 days	Spectrometry	GeLi	$2.2*10^{-6}$ - $1.1*10^{4}$	Twice a week
Iodine filters exposition 7 days	Spectrometry	GeLi	$1.1*10^{-6}$ - $8.0*10^{3}$	Weekly
Iodines filters exposition 1 month	Spectrometry	GeLi	$3.0*10^{-7}$ - $3.7*10^{3}$	Monthly
Noble gas	Spectrometry (Marinelly geometry, 62 l chamber)	HP Ge (30%)	0.7 - $2.0*10^{5}$	Weekly
Aerosol filters exposition 1 month (radiochemical separation)	Total alpha activity	SSCD	$1.0*10^{-7}$ - 20	Monthly
Aerosol filters exposition 1 month (radiochemical separation)	Total activity of: Sr-89 + Sr-90 Sr-89 Sr-90	 SSCD SSCD SSCD	 $1.0*10^{-7}$ - 50 $1.0*10^{-7}$ - 36 $1.0*10^{-7}$ - 22	 Monthly Monthly Monthly

2. Building 150

		Detector	Detection range (Bq/l)	Frequency
Aerosol filters exposition 7 days	Total beta activity Spectrometry	Geiger-Muller HP Ge (30%)	$9.2*10^{-7}$ - $1.85*10^{7}$ $8.0*10^{-7}$ - $6.2*10^{4}$	Weekly Weekly
Noble gas	Spectrometry (Marinelly geometry, 62 l chamber)	HP Ge (30%)	0.7 - $2.0*10^{5}$	Weekly
Iodine filters exposition 7 days	Spectrometry	GeLi	$1.1*10^{-6}$ - $8.0*10^{3}$	Weekly
Aerosol filters exposition 1 month (radiochemical separation)	Total activity of: Sr-89 + Sr-90 Sr-89 Sr-90	 SSCD SSCD SSCD	 $1.0*10^{-7}$ - 50 $1.0*10^{-7}$ - 36 $1.0*10^{-7}$ - 22	 Monthly Monthly Monthly

APPENDIX 7

IGNALINA NPP
SITE-RELATED ENVIRONMENTAL MONITORING PROVISIONS

1. On-line systems: SkyLink

Probe: Gamma TRACER detector, Genitron Instruments GmbH
Number of probes: 12 installed on the site perimeter; 10 in the sanitary protection zone
Measurement range: 0.1 µSv/h – 10 Sv/h
Frequency of measuring: 60 minutes integration (normal operation)
10 minutes integration (if dose rate exceeds 1 µSv/h)
Energy measurement range: 45-3000 KeV

2. Off-line systems

2.1 High-volume air sampling stations (HVAS)

Number installed: 6
Throughput: 600 m^3/h (per sampling station)
Filter type: FPP-15 (double) fibre filter
Filter dimensions: 120 x 41cm
Frequency: filter changed 3 times a month
Laboratory: gamma spectrometry, Sr-90
MDA[(5)]: see table below:

Nuclide	Ra-223	K-40	Co-60	Co-57	Cs-134	Cs-137	I-131	Cd-109	Be-7	Sr-90
MDA Bq/m^3	1.0E-05	1.6E-05	7.9E-07	4.5E-07	7.0E-07	5.1E-07	6.4E-06	1.3E-05	6.2E-06	5.0E-08

2.2 Dry/wet deposition

Number installed:
1. 6 rectangular stainless steel collectors 50 x50 x 15 cm (one on the roof of every HVAS station)
2. 10 cylindrical collectors of 80 cm diameter with Petrianov fabric

Filter type: Petrianov fabric filter
Frequency: filters changed once a month
Laboratory: gamma spectrometry
MDA: see table below:

Nuclide	Ra-223	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Be-7
MDA Bq/(km^2*day)	1.1E+6	1.3E+5	6.7E+3	4.5E+3	6.2E+3	6.5E+3	8.6E+4	1.0E+5

2.3 Outlet channel

Sample volume: 10 liters
Frequency: every working day
Laboratory: gamma spectrometry, H-3, Pu isotopes, Sr-90

5 Minimum Detectable Activity (detection limit).

MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	H-3	Sr-90	Pu-239 Pu-240
MDA Bq/l	2.0E-2	1.4E-3	9.6E-4	1.3E-3	1.5E-3	2.5E-2	2.5	5.8E-4	2.9E-4

2.4 Inlet channel

Sample volume: 10 liters
Frequency: every working day
Laboratory: gamma spectrometry, Pu isotopes, Sr-90
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90	Pu-239 Pu-240
MDA Bq/l	2.0E-2	1.4E-3	9.6E-4	1.3E-3	1.5E-3	2.5E-2	5.8E-4	2.9E-4

2.5 Drukšiai Lake water

Sampling place: Drukšiai Lake, “zero background point”, near surface
Sample volume: 10 liters
Frequency: once a year
Laboratory: gamma spectrometry, Sr-90
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90
MDA Bq/l	8.4E-2	3.1E-3	3.4E-4	4.6E-3	3.4E-3	5.7E-2	7.5E-4

2.6 Sewage water

Sampling place: before and after sewage water processing plant
Sample volume: 10 liters
Frequency: 1 per 10 days
Laboratory: gamma spectrometry, Sr-90, H-3
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90	H-3
MDA Bq/l	1.2E-1	6.2E-3	3.7E-3	8.4E-3	6.3E-3	9.9E-2	1.0E-3	2.5

2.7 Hot water supply

Sampling place: building 438 at the entrance of Visaginas
Sample volume: 10 liters
Frequency: 1 per 3 month
Laboratory: gamma spectrometry, Sr-90
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90
MDA Bq/l	7.6E-2	4.9E-3	3.2E-3	4.2E-3	5.0E-3	5.7E-2	7.5E-4

2.8 Water in drill-hole

Sampling place: drill-hole on site (50) and on Spent Fuel Storage (19)
Sample volume: 10 liters
Frequency: 2 times per year
Laboratory: gamma spectrometry, Sr-90, H-3
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90	H-3
MDA Bq/l	1.4E-1	1.0E-2	3.1E-3	6.5E-3	7.7E-3	1.1E-1	7.5E-4	2.5

2.9 Drinking water supply

Sampling place: Potable water processing plant
Sample volume: 10 liters
Frequency: 4 times per year
Laboratory: gamma spectrometry
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109
MDA Bq/l	1.3E-1	7.9E-3	5.4E-3	7.7E-3	7.8E-3	9.1E-2

2.10 Drinking water wells

Sampling place: wells at Tilžė and Gaidė villages
Sample volume: 10 liters
Frequency: 4 times per year
Laboratory: gamma spectrometry, H-3
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	H-3
MDA Bq/l	1.3E-1	7.9E-3	5.4E-3	7.7E-3	7.8E-3	9.1E-2	2.5

2.11 INPP drainage

Sampling place: on site, near building 159
Sample volume: 10 liters
Frequency: 4 times per year
Laboratory: gamma spectrometry, H-3
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	H-3
MDA Bq/l	1.1E-1	3.7E-3	2.3E-3	4.7E-3	4.3E-3	7.1E-2	2.5

2.12 Snow

Sampling place: near the HVAS stations
Sample volume: 1 m^2
Frequency: once a year
Laboratory: gamma spectrometry, Sr-90
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90
MDA Bq/(m^2*day)	1.3E-1	6.0E-3	2.7E-3	5.4E-3	5.8E-3	9.8E-2	1.3E-1

2.13 Drainage water (1)

Sampling place: Spent Fuel Storage drainage, Drainage-1 INPP, Drainage-3 INPP
Sample volume: 10 liters
Frequency: 1 per 10 days
Laboratory: gamma spectrometry, Sr-90, H-3
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90	H-3
MDA Bq/l	2.0E-1	1.2E-2	6.6E-3	9.5E-3	1.1E-2	3.2E-2	7.5E-4	2.5

2.14 Drainage water (2)

Sampling place: near open distributive system
Sample volume: 10 liters
Frequency: once a month
Laboratory: gamma spectrometry, Sr-90
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90
MDA Bq/l	1.2E-1	6.1E-3	2.8E-3	5.0E-3	5.9E-3	1.9E-1	2.5E-4

2.15 Silt from sewage processing plant

Sampling place: sewage processing plant
Sample volume: 3 liters
Frequency: once a month
Laboratory: gamma spectrometry, Sr-90, Pu isotopes
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	I-131	Cd-109	Sr-90	Pu-239 Pu-240
MDA Bq/kg	4.5	0.23	0.45	0.49	0.36	0.35	9.0	2.5	0.35

2.16 Sediments (1)

Sampling place: Spent Fuel Storage drainage, Drainage-1 INPP, Drainage-3 INPP, discharge channel, after sewage processing plant
Sample volume: 3 liters
Frequency: 1 time per 3 month (during the navigation period)
Laboratory: gamma spectrometry, Sr-90
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90
MDA Bq/kg	3.4	0.22	0.31	0.33	0.24	7.9	3.7

2.17 Sediments (2)

Sampling place: Drukšiai Lake, "zero background point"
Sample volume: 3 liters
Frequency: once a year (summer)
Laboratory: gamma spectrometry, Sr-90, Pu isotopes
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90	Pu-239 Pu-240
MDA Bq/kg	135	6.3	2.9	5.4	4.2	133	1.8	3.5

2.18 Water-plants (1)

Sampling place: Drainage-1 INPP, Drainage-3 INPP, inlet channel, discharge channel, after sewage processing plant
Sample volume: 3 liters
Frequency: 1 time per 3 month (during the navigation period)
Laboratory: gamma spectrometry, Sr-90
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90
MDA Bq/kg	220	9.90	11.1	13.4	14.5	276	1.50

2.19 Water-plants (2)

Sampling place: Drukšiai Lake, "zero background point"
Frequency: once a year (summer)
Laboratory: gamma spectrometry, Sr-90
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90
MDA Bq/kg	35	2.1	1.1	1.7	1.4	32	1.5

2.20 Fish

Sampling place: Drukšiai Lake
Sample volume: 5 kg
Frequency: 2 times per year (spring, autumn)
Laboratory: gamma spectrometry, Sr-90
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90
MDA Bq/kg	2.4	0.23	0.25	0.20	0.18	8.0	0.3

2.21 Soil

Sampling place: near HVAS stations
Sample volume: 0.6 m^2
Frequency: once a year
Laboratory: gamma spectrometry, Sr-90
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90
MDA Bq/m^2	12	1.1	1.2	1.1	0.73	33	2.5
MDA Bq/kg	2.3	0.20	0.22	0.20	0.14	6.2	0.3

2.22 Grass

Sampling place: near HVAS stations
Sample volume: 1 m^2
Frequency: 1 time per month from May till October
Laboratory: gamma spectrometry, Sr-90
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90
MDA Bq/kg	31	1.8	1.3	1.7	1.9	52	0.40

2.23 Moss

Sampling place: At Vilkaragis and Grikeniškė peninsula, Tilžė and Gaidė villages, Visaginas town
Frequency: once a year
Laboratory: gamma spectrometry
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109
MDA Bq/kg	34	1.6	1.5	2.1	1.7	77

2.24 Mushrooms

Sampling place: At Vilkaragis and Grikeniškė peninsula, Tilžė and Gaidė villages, Visaginas town
Frequency: once a year
Laboratory: gamma spectrometry
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109
MDA Bq/kg	5.8	0.33	0.21	0.29	0.23	6.9

2.25 Milk

Sampling place: Tilžė
Sample volume: 3 liters
Frequency: once a year
Laboratory: gamma spectrometry
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	I-131	Cd-109
MDA Bq/kg	1.2	0.10	0.11	0.09	0.10	0.10	3.8

2.26 Potatoes

Sampling place: Tilžė
Sample volume: 5 kg
Frequency: once a year
Laboratory: gamma spectrometry
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109
MDA Bq/kg	3.5	0.21	0.12	0.16	0.20	4.8

2.27 Cabbage

Sampling place: Tilžė
Sample volume: 5 kg
Frequency: once a year
Laboratory: gamma spectrometry, Sr-90
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109	Sr-90
MDA Bq/kg	3.0	0.22	0.14	0.19	0.22	6.2	5.0E-2

2.28 Corn

Sampling place: Tilžė
Sample volume: 5 kg
Frequency: once a year
Laboratory: gamma spectrometry
MDA: see table below:

Nuclide	K-40	Co-60	Co-57	Cs-134	Cs-137	Cd-109
MDA Bq/kg	2.4	0.13	0.92	0.11	0.14	4.3

2.29 Environmental Dose

Sampling place: 30 measuring places in monitoring area (30 km around INPP)
Device : TLD (LiF-7)
Frequency: 2 times per year
Measurement range: 0.01 mSv– 10 Sv
Energy measurement range: 15-3000 KeV

APPENDIX 8

IGNALINA NPP - SITE-RELATED ENVIRONMENTAL MONITORING LOCATIONS OF ON-LINE SYSTEMS

Fig.1. **SkyLink system within the INPP 30-km area**

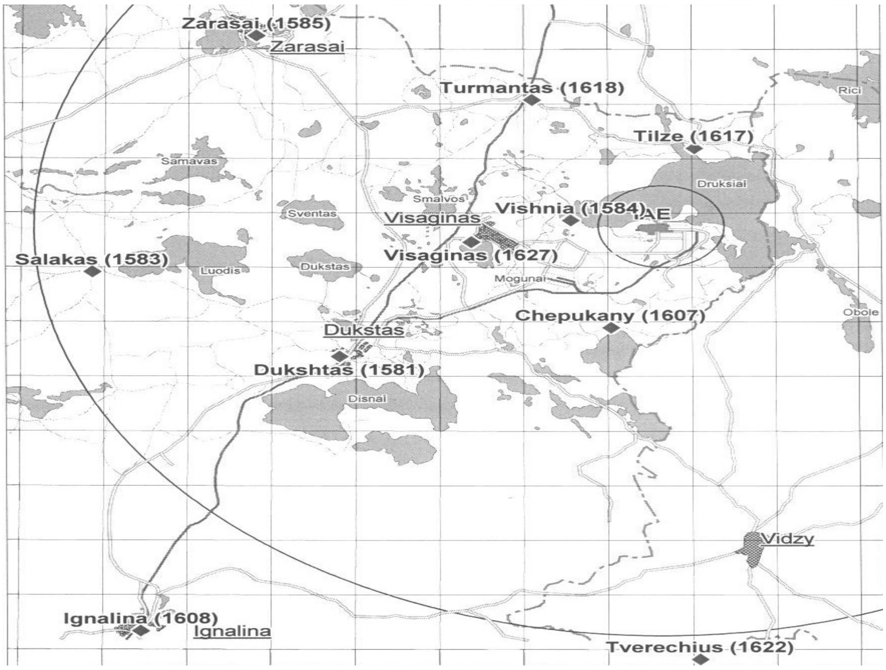
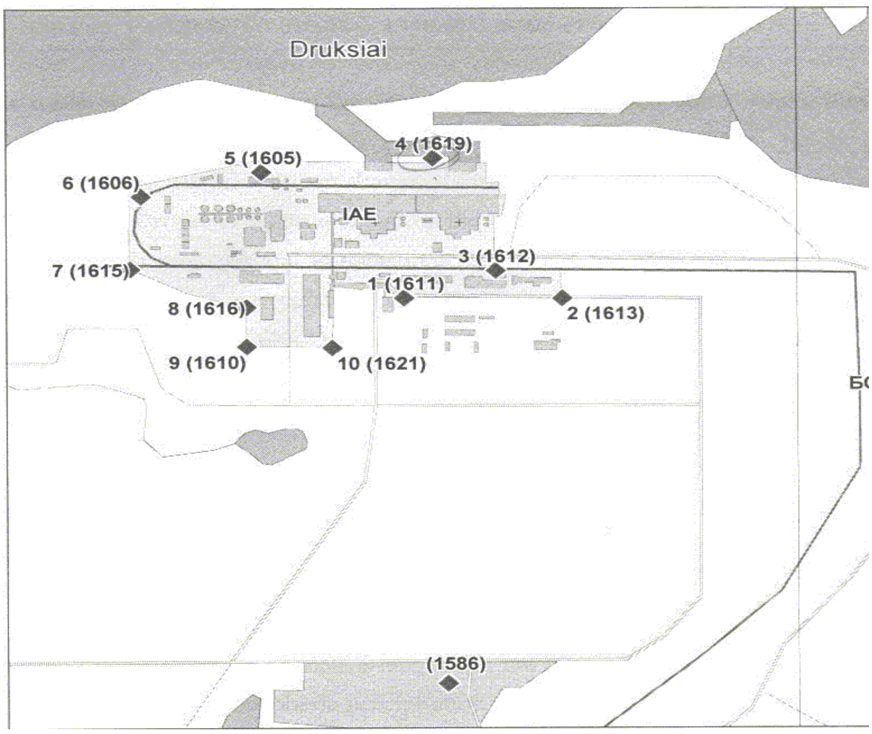


Fig.2. **SkyLink System within INPP 3-km area**



APPENDIX 9

IGNALINA NPP - SITE-RELATED ENVIRONMENTAL MONITORING SAMPLING NETWORK LOCATIONS

Fig. 3. Air sampler locations within the INPP 30-km area

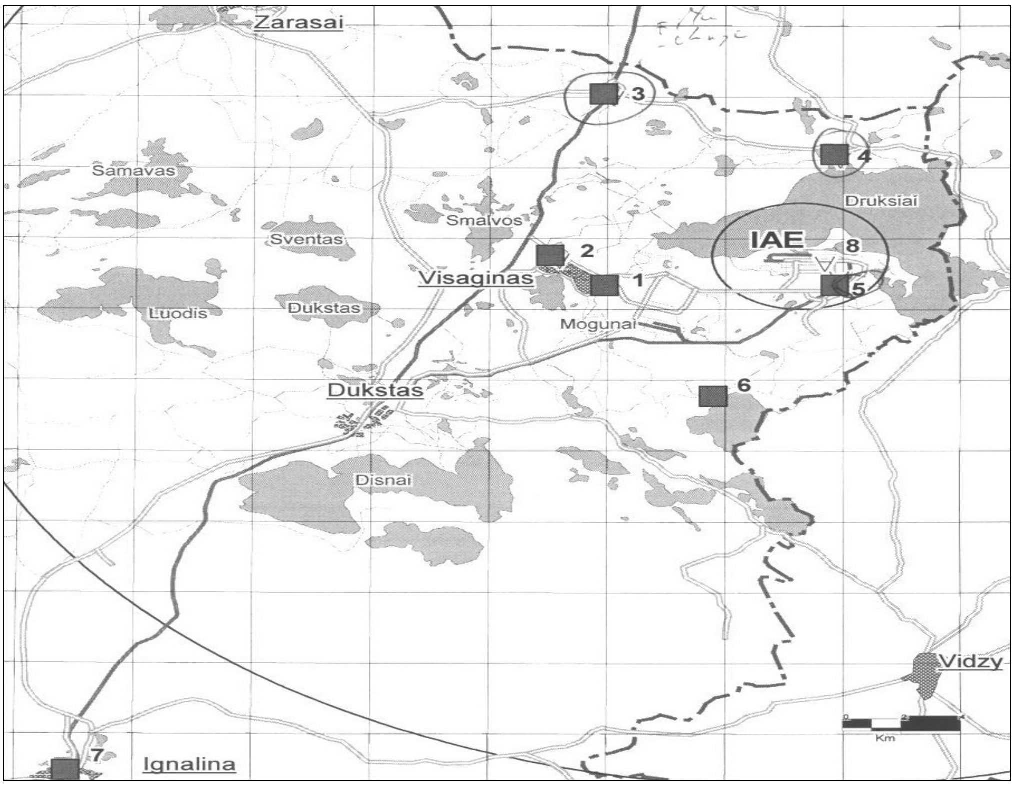


Fig. 4. Precipitation and drainage water sampling locations on the INPP site

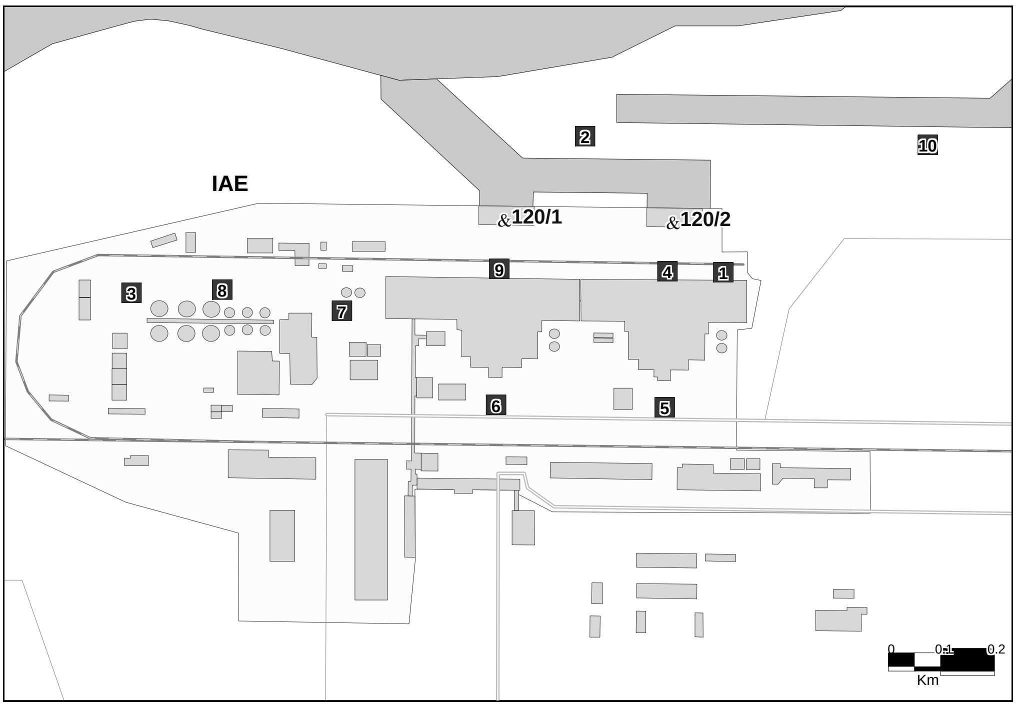
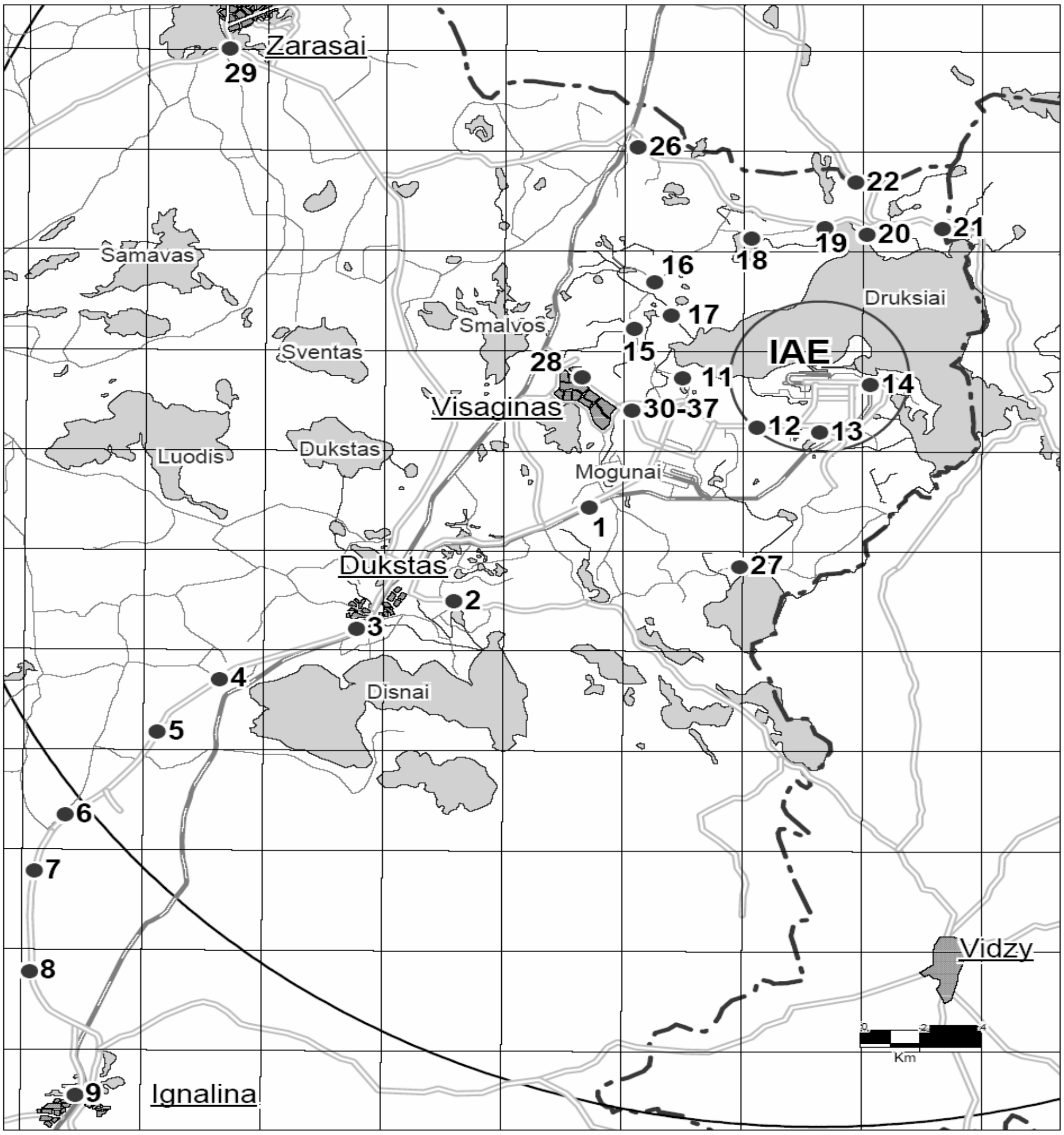


Fig. 5. TLD locations within the INPP 30-km area



APPENDIX 10

IGNALINA NPP - STATUTORY ENVIRONMENTAL SAMPLING PROGRAMME

Sample and Location	Sampling Frequency	Type of Measurement
Aerosols: Visaginas hospital (2), Tilze settlement (4), Turmantas settlement (3), bldg. 438 (1), INPP warehouse (5), Cepukany village, (6) Ignalina town (7) - [see appendix 9 fig.3].	3 times a month 2 times a year (spring and autumn)	Gamma-nuclide content Sr-90
Precipitation: Tilze settlement (4), Turmantas settlement (3), bldg. 438 (1), Cepukany village, (6) Ignalina town (7) - [see appendix 9 fig.3]. On the INPP site (10 locations) - [see appendix 9 fig.4].	Monthly	Gamma-nuclide content
Water from the intake and discharge legs of the cooling channel.	20 times a month (during working days) Twice a year (spring and autumn) Monthly	Gamma-nuclide content Sr-90, Pu-239, Pu-240 H-3 (only for the discharge)
Water and algae of Lake Drūkšiai (5 locations).	Once a year, during the summer	Gamma-nuclide content Sr-90
Service and domestic sewage waters, before and after the water treatment plant.	Every 10 days Twice a year (spring and autumn) Monthly	Gamma-nuclide content Sr-90 H-3
Water from the INPP heating system.	Every three months (January, April, July, October) Once a year, during the winter	Gamma-nuclide content Sr-90
Ground water (boreholes on the INPP and Spent Fuel Storage Facility [SFSF] sites).	2 times a year (spring and autumn)	Gamma-nuclide content Sr-90 H-3

Cont'd

On-site drinking water and drinking water from wells at Tilze and Gaide villages.	4 times a year (February, March, August, November)	Gamma-nuclide content H-3 (only for wells)
Water of the bypass channel around the industrial waste dump.	Monthly Once a year, during the winter 4 times a year	Gamma-nuclide content Sr-90 H-3
Snow (at all the precipitation sampling locations)	Once a year, during the winter	Gamma-nuclide content Sr-90
Water of the INPP and SFSF sites' domestic sewage and surface rainwater draining systems.	Every 10 days Monthly Once a year, during the winter	Gamma-nuclide content Sr-90 H-3
Drainage water from the INPP site (specifically for buildings 120/1 and 120/2).	Monthly Once a year, during the winter	Gamma-nuclide content Sr-90
Sludge from the SFSF site	Monthly 2 times a year (spring and autumn)	Gamma-nuclide content Alpha-nuclides
Sediment in the INPP and SFSF sites' domestic sewage and surface rainwater draining systems; sediment in the discharge channel after the water treatment facility (during the navigation season).	4 times a year Yearly (during spring)	Gamma-nuclide content Sr-90
Sediment in Lake Drūkšiai (5 locations) - during the navigation season.	Yearly (during summer) Yearly (during summer) Every 5 years for each observation point	Gamma-nuclide content in the upper layer (Ø 42 mm) Sr-90 in the the upper layer (Ø 42 mm, 3 cm depth) Profile of gamma-nuclides distribution (Ø 42 mm, 7-15 layers of 3-4 cm each)
Algae from the INPP and SFSF sites' domestic sewage and surface rainwater draining systems (during the navigation season).	Every 3 months	Gamma-nuclide content

Cont'd

Algae from the intake leg of the cooling channel (during the navigation season).	Every 3 months	Gamma-nuclide content Micro-algae on plexiglas
Algae from the discharge leg of the cooling channel (during the navigation season).	Every 3 months Every year in autumn	Gamma-nuclide content Micro-algae on plexiglas Sr-90
Algae from the dischareg channel after the water treatment facility.	Every 3 months Every year in autumn	Gamma-nuclide content Sr-90r
Fish of all species from Lake Drūkšiai.	2 times a year in spring and autumn Yearly in spring	Gamma-nuclide content Sr-90
Soil at all the constant survey points and in the Grikenishky settlement.	Yearly during autumn	Gamma-nuclide content Sr-90r
Gramma grass at all the constant survey points and in the Grikenishky settlement.	Monthly from May to October	Gamma-nuclide content Sr-90
Mushrooms and moss in the area of the Vilkaragis, Grikenisky, Tilze, Gaige and Visaginas settlements. Roedeer meat. Crops (rye or oats). Meat foods (pork and beef). Potatoes.	Yearly in autumn	Gamma-nuclide content
Milk (Tilze settlement)	Monthly Yearly in autumn (integrated sample)	Gamma-nuclide content Sr-90
Cabbage	Yearly in August	Gamma-nuclide content Sr-90

Gamma-nuclide content is measured by means of semiconductor detector. The nuclide library of the gamma spectrometry system contains the following nuclides:

Be-7, Na-22, K-40, Cs-46, Cr-51, Mn-54, Co-57, Co-58, Fe-59, Co-60, Cu-64, Zn-65, Zn-69m, Se-75, Br-82, Rb-83, Kr-85, Sr-85, Kr-87, Y-88, Zr-89, Y-91, Nb-94, Nb-95, Nb-95m, Zr-95, Tc-96, Zr-97, Mo-99, Tc-99m, Ru-103, Rh-105, Ru-106, Cd-109, Sn-113, Sb-122, I-124, Sb-124, Sb-125, Xe-125, I-126, Sb-126, Te-129x, I-130, I-131, Xe-131m, Te-132, Ba-133, I-133, Xe-133, Xe-133m, Cs-134, Cs-136, Cs-137, Ce-139, Ba-140, La-140, Ce-141, Ce-144, EU-152x, Tb-160, Rb-210, Rn-219, Ra-223, Ra-226, Th-227, Th-232, Ra-234, Ra-234m, Am-241

EPA - ENVIRONMENTAL MONITORING PROGRAMME

1. National programme

High volume air sampler

Location:	Utena city (1 sampler)	
Type:	JL-900 “SnowWhite”	glass fibre filter of 1μm (aerosols) activated carbon cartridge (iodines)
Throughput:	150 m^3/h (air intake 10 m above ground level)	
Frequency:	Filters changed 2 times a week (on average)	
Laboratory:	Activity concentration of Be-7, Cs-137 and I-131	

Surface waters and sediments

Location:	Drūkšiai Lake and others (5), various rivers
Frequency for lakes:	Quarterly (water) / yearly (sediment)
Laboratory:	Activity concentration of Cs-137 and Sr-90 5-yearly assessment of Pu-238 and Pu-239 in sediments
Frequency for rivers:	Quarterly (water - 9 rivers) / yearly (sediment - 12 rivers)
Laboratory:	Activity concentration of Cs-137 and Sr-90

Marine samples

Locations:	Baltic Sea (2 locations) and Curonian Lagoon (1 location)
Frequency:	Baltic Sea: quarterly (water) / quarterly (sediment) Curonian Lagoon: quarterly (water) / quarterly (sediment)
Laboratory:	Activity concentration of Cs-134, Cs-137, K-40, Sr-90

Precipitation

Locations:	5 stations: Vilnius, Kaunas, Klaipeda, Utena, and Dukstas
Frequency:	Total beta activity every 5 days, gamma and Sr-90 analysis quarterly
Laboratory:	Total beta activity, gamma spectrometry, Sr-90, Cs-137, Be-7

2. INPP related (within the 30 km zone)

Permanent Monitoring Station (PMS systems)

Probe / detector type:	NaI Geiger-Müller tube
Number installed:	4 in the INPP area (+ 5 spread over the national territory)
Measurement range:	0.05 μSv/h – 1 Sv/h (for gamma doserate) 0.37 Bq/m^3 – 3.7 Bq/m^3 (for iodine and aerosol activity)
Measurement frequency:	1 hour (in emergency situations every 10 minutes)

AAM-95

Probe / detector type:	Geiger-Müller tube
Number installed:	2 in the INPP area
Measurement range:	0.05 μSv/h – 1 Sv/h (for gamma dose rate)
Measurement frequency:	1 hour (in emergency situations every 15 minutes)

Surface water and sediments

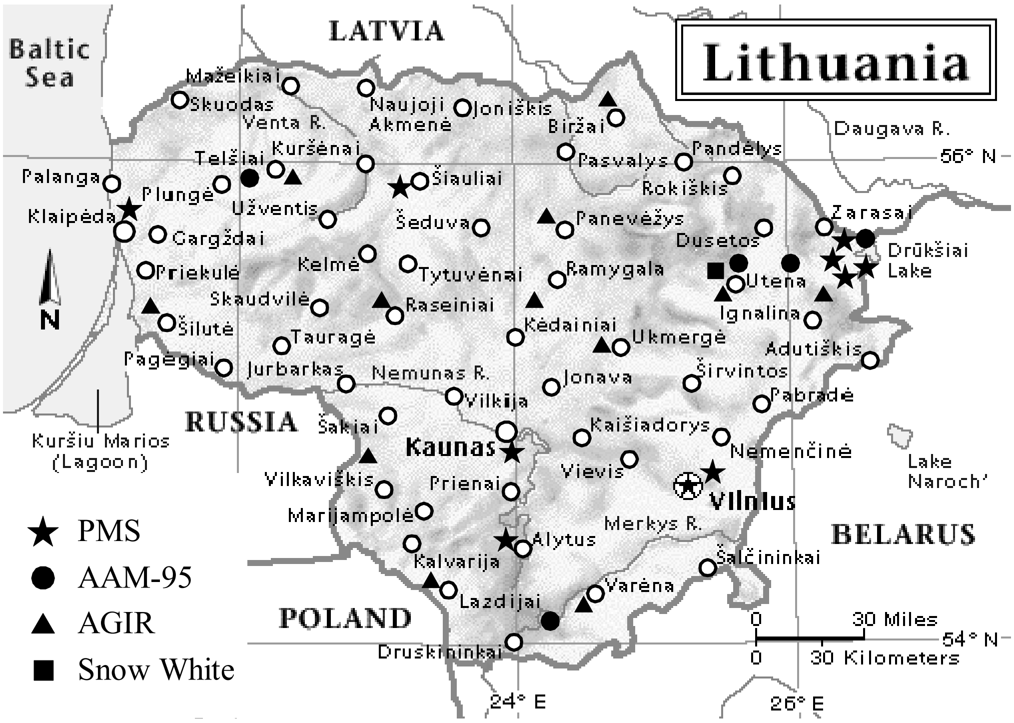
Location:	Drūkšiai Lake discharge channel
Frequency:	2 times per year
Laboratory:	Gamma spectrometry and Sr-90

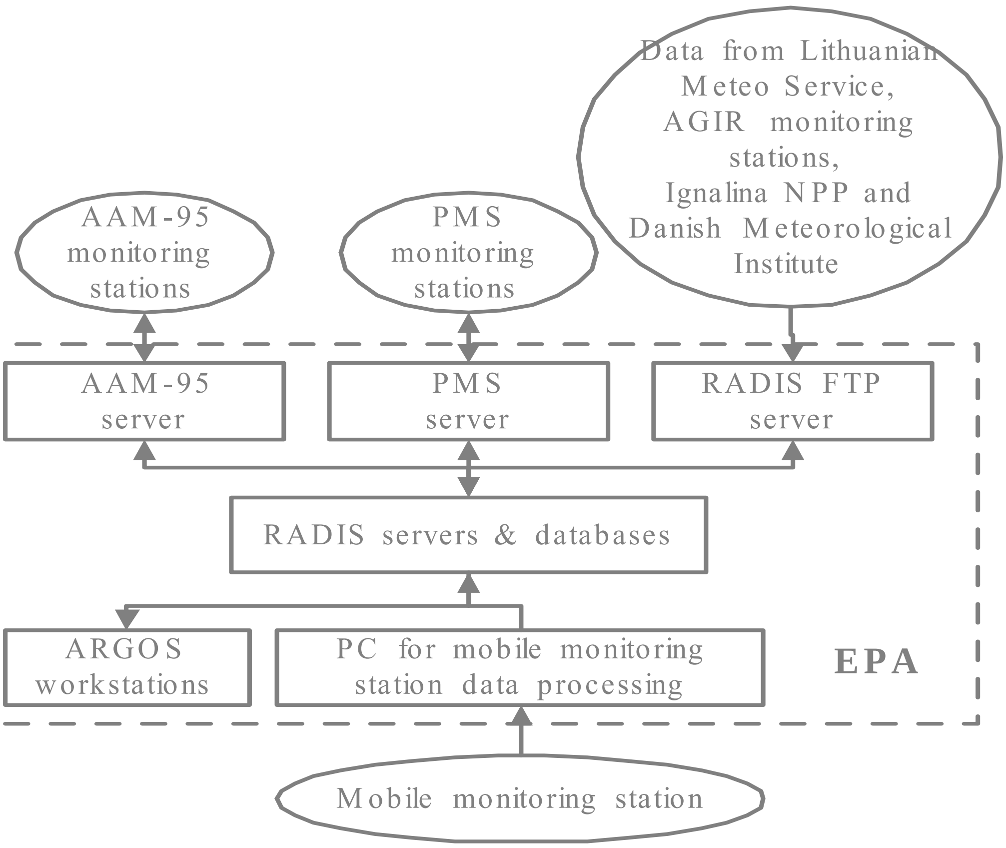
Grass, leaves, ground

Location:	Sanitary zone
Frequency:	Yearly
Laboratory:	Gamma spectrometry

APPENDIX 12

EPA - AUTOMATED ENVIRONMENTAL MONITORING SYSTEM





APPENDIX 13

RPC - ENVIRONMENTAL MONITORING PROGRAMME

1. National programme

1.1 The dense network

Local food

Location:	7 locations: INPP area; Ignalina, Zarasai and Utena districts; Kaunas, Klaipėda, Šiauliai, and Panevėžys regions
Frequency:	Milk (quarterly); meat and fish (twice a year), vegetables and grain (yearly) Mushrooms and wild beries (during the growing seasons only)
Laboratory:	concentration of Cs-137 and Sr-90 For mushroom: Cs-137

Drinking water

Location:	7 locations: INPP area; Ignalina, Zarasai and Utena districts; Kaunas, Klaipėda, Šiauliai, and Panevėžys regions
Sampling:	Per location: 3 private wells and one water supply system
Frequency:	Quarterly
Laboratory:	Gross alpha activity, gross beta activity (excl. H-3, C-14, K-40 and radon + progeny), tritium

1.2 The sparse network

Mixed diet and milk

Location:	One sampling point in the Vilnius region
Sampling:	Hospital menu (mix of local and imported products)
Frequency:	Monthly
Laboratory:	Concentrations of Cs-137 and Sr-90

Drinking water

Location:	One sampling point in the Vilnius region
Sampling:	From the water supply system and from 3 private wells
Frequency:	Monthly
Laboratory:	Gross alpha activity, gross beta activity (excl. H-3, C-14, K-40 and radon + progeny), tritium

1.3 Dose rate monitoring with TLD

Location:	Ignalina and Kupiškis districts
Number:	32 locations
Measurements:	App. 130 per year

1.4 Precipitation

Location:	One station in Vilnius
Frequency:	Monthly
Laboratory:	Total beta (+ quarterly Cs-137 and Sr-90 on bulked sample)

Cont'd

2. INPP related (within the 50 km zone)

Local food

Location:	3 locations in INPP area; Ignalina, Zarasai and Utena districts
Frequency:	Milk (quarterly); meat and fish (twice a year), vegetables and grain (yearly) Mushrooms and wild beries (during the growing seasons only)
Laboratory:	Concentration of Cs-137 and Sr-90 For mushrooms: Cs-137

Drinking water

Location:	3 locations in INPP area; Ignalina, Zarasai and Utena districts
Sampling:	Per location: 3 private wells and one water supply system
Frequency:	Quarterly
Laboratory:	Gross alpha activity, gross beta activity (excl. H-3, C-14, K-40 and radon + progeny), tritium