9 MONITORING

9.1 INTRODUCTION

Monitoring is the collection of specific data about selected environmental variables (impact indicators) in space and time, with the objective of supplying information on the amplitude and rate of change in these variables so that, in turn, it allows assessment of related environmental impacts. The purpose of the environmental monitoring is to detect impacts as they occur, to estimate their magnitude and ensure that they are the consequence of a well identified project or activity. Monitoring includes the follow-up of impacts and their verification against predictions. Monitoring also allows the assessment of the effectiveness of mitigation and remedial measures. This information should be the basis for modifying either the activity or the mitigation measures. In this chapter a proposal for the monitoring system of the new NPP is presented. Applicable parts of the new monitoring should be implemented as soon as possible, well in advance of commissioning of the NNPP in order to ensure sufficient knowledge about the conditions of the environment after INPP has been shut down.

The Ministry of Environment of the Republic of Lithuania controls implementation of environmental monitoring, quality of monitoring data and information, and compliance with the standards and other normative legislation. The monitoring is to be performed in accordance with a regulatory approved Environmental Monitoring Program. The monitoring program shall be prepared according to the Lithuanian legislation and Regulations on Environmental Monitoring (*Law on Environment Protection I-2223, State Journal, 2005, No. 47-1558; Law on Environment Monitoring No. X-595, State Journal, 2006, No. 57-2025; Regulation on Performance of Environment Monitoring of Economy Entities, State Journal, 2004, No. 181-6712; Regulation on Ground Water Monitoring of Economy Entities, State Journal, 2003, No. 101-4578*), Lithuanian Radiation Protection Standards (*Lithuanian Hygiene Standard HN 73:2001 "Basic Standards of Radiation Protection", State Journal, 2002, No. 11-388*) and Regulatory Documents on the Environment (*Regulatory Document on the Environment LAND 42-2007 "On the Restrictions on the Release of Radionuclides from Nuclear Installations and Procedure for the Authorization of Release of Radionuclides and Radiological Monitoring", State Journal, 2007, No. 138-5693; Regulatory Document on the Environment LAND 36-2000 "Measurement of Environmental Elements Contamination with the Radionuclides", State Journal, 2005, No. 59-2083*). The monitoring data is being summarized and submitted to the competent institutions annually.

According to Article 5 of the Law on Environmental Monitoring (*No. X-595, State Journal, 2006, No. 57-2025*), the following shall be observed, evaluated and forecasted during the environmental monitoring:

- State of the ambient air, waters, underground, soil and biota;
- State of the natural and anthropogenically affected natural systems (natural habitats, ecosystems) and landscape;
- Physical, radiological, chemical, biological and other sources of anthropogenic impact and influence thereof upon the environment;
- The change and tendencies of the global processes taking place within the environment (acid rain, change in the ozone layer, greenhouse effect etc.).

Environmental monitoring in the vicinity of the nuclear power plant supplements monitoring of the radioactive materials which are inevitably released from the power plant with the exhaust air and liquid effluents. Furthermore, it records the radiological impact of accidents. For this purpose, the path-ways (air and precipitation, ground and vegetation, food chains on the ground, surface water and groundwater, and food chains in water) are each kept under surveillance for radioactivity.

Meteorological factors such as wind direction and velocity, precipitation and inversion phenomena, which are of significance for the dispersion of radioactive materials, are surveyed in order to assess the exposure path-ways in the vicinity of the nuclear power plant.

The existing Ignalina NPP environmental monitoring program covers the following parts:

- Monitoring of concentration of radionuclide activity in the air and atmospheric precipitation;
- Monitoring of the chemical composition of water in the discharge channel and storm sewage drainage from the INPP territory;
- Monitoring of water quality in Lake Druksiai and of groundwater (physical-chemical parameters);
- Monitoring of nuclides concentration in the lake, the outlet channel, the rain sewerage system channels and groundwater;
- Meteorological observations;
- Monitoring of dose and dose rate in the sanitary protection (3 km) and surveillance (30 km) areas;
- Monitoring of radionuclide activity concentration in fish, algae, soil, grass, sediments, mushrooms, and plants;
- Monitoring of radionuclide activity concentration in food products (milk, potatoes, cabbage, meat, grains).

9.2 ENVIRONMENTAL MANAGEMENT SYSTEM

An environmental management system (EMS) will be implemented during both construction and operation of the NNPP. The EMS will be certified according to the ISO 14001 standard or a similar standard. The system will cover all the operations at the NNPP. The EMS involves measures for the benefit of the environment as part of everyday operation of the NNPP. Environmental impacts can be managed systematically through the EMS and the system obligates to commitment of the constant improvement of the level of environmental performance. One of the objectives of the EMS is to limit the negative environmental impacts caused by releases from the NNPP. The EMS thus requires monitoring measures to be implemented in the vicinity of the NNPP.

9.3 MONITORING OF RADIOACTIVE RELEASES AND LOADS TO THE ENVIRONMENT AND PEOPLE

9.3.1 Current monitoring system

A radioecological monitoring program (for observing of radionuclides in components of the ecosystem) in the surroundings of Ignalina NPP has been implemented since 1978, i.e. five years prior to commissioning of the first reactor. Works for observation of changes in the environment of Ignalina NPP were performed according to the Complex radiation-ecological analysis program (1978–1985–1995). The program was carried out by the Moscow Institute of Energotechnological Science Research and Construction (general designer of Ignalina NPP) and five institutes of the former Lithuanian Research

Academy – Institute of Physics, Energetics, Zoology and Parasitology, Geography and Botany. The fundamental radioecological status in the environment of the constructed power plant is described in the general report of all institutions (*Radiological-Ecological Investigation of INPP Region Before Start of Operation, 1985*).

Measurements of radioecological observations increased especially during research of consequences of the Chernobyl NPP accident to Lithuania and Ignalina NPP region. Monitoring results of the constant concentrations of radionuclide activities in the air, precipitation, soil, in the water of Lake Druksiai and bottom sediments after commissioning of the first Ignalina NPP reactor (1983), and after the Chernobyl NPP accident, are summarized in a monograph type publication (*Thermal Power Generation and Environment, 1992*).

Scientific research work in the environment of INNP was partially interrupted after the independence and was renewed following the State Scientific Program "Atomic Energy and the Environment," approved by the Lithuanian government (*Collection of Research Reports, 1993–1997, Vilnius, Vol. 1–5*).

The Institute of Physics in 1998, based on the research results of the Chernobyl NPP accident consequences and the Ignalina NPP environment, initiated the foundation of the Lithuanian radioecological monitoring system (*11 November, 1998, Decision of Council of Ministers No. 332*). Analysis of earth surface contamination by radionuclides brought from Chernobyl was performed. The dosimetric data registration system with 17 monitoring points in Lithuanian Meteorological Stations (AGIR), and the system for automated radionuclide emission registration (RADIS) were established.

9.3.1.1 Monitoring of radioactive releases

The Environment Protection Agency of the Ministry of Environment is responsible for the system AGIR, supplemented with monitoring points with gamma specter registering scintillating detectors, which operates as an early warning system in Lithuania. Furthermore the Environment Protection Agency controls the system RADIS while custom monitoring observations have gradually been transferred to the Radiation Protection Center.

All emissions from the Ignalina nuclear power plant, made exclusively through the vent stack and the waste water, are systematically monitored. The system RADIS is installed in the Ignalina NPP as an automated radiation control system (ASKRO) showing real time activities of radionuclides on a computer screen and on three various scale maps. The automated radiation control system includes automated registration of radiation of radionuclides in the surface air and in the nuclear power plant stack releases and a system for calculation of radionuclide transfer in the air. The system reflects real time concentrations of radionuclide activity in the air of the sanitary protection zone. The RADIS system is also to be applied in case of accidents. The calculations give the radiation dose at the height of both Ignalina NPP stacks.

Content of radionuclides in releases is determined on the basis of gamma specter measurement of spectrometric aerosol particles and inert gases in samples from the ventilation air stacks, and this allows evaluation of penetration of every radionuclide to the surface air. Measuring of concentrations of radionuclide activities in the surface air at seven observation points in the area is conducted every tenth day.

Monitoring of radioactivity in water is performed at the waste water collection point (on the INPP site), at the waste water receiving point (at waste water treatment plant) and halfway down a stream between the waste water treatment plant and Lake Druksiai.

Monitoring of the radioactivity releases with aqueous waste is also performed batch-wise in specific discharge containers. Other measurements cover 5 discharge points and 6 stations in Lake Druksiai (Figure 9.3-1).

Figure 9.3-1. Sampling points in Lake Druksiai.

Concentrations of tritium activity in waste water have been monitored since 1999. Beta radiation of low energy tritium gives a greater input to the ecological dose in Lake Druksiai than radiation of other radionuclides. Measurement results show that tritium in water of Lake Druksiai accumulates via industrial storm and household waste water channels. A summary of the radiation monitoring of the INPP liquid discharges into the environment is presented in Table 9.3-1. A summary of the radiation monitoring of the INPP aquatic environment is presented in Table 9.3-2.

Table 9.3-1 Summary of the radiation monitoring of the INPP liquid discharges to the environment.

RADIATION MONITORING OF LIQUID DISCHARGES	
Total β activity	Weekly: service water taken by Reactor Units 1,2; water, discharged by reactor and turbine compartments; water, discharged from Bld. 150; monthly: service water after the heat exchangers; at every discharge – water from special laundry.
Volumetric activity of radionuclides	Monthly: water, discharged by reactor and turbine compartments; service water after the heat exchangers; water, discharged from Bld. 150, pit of corridor 003 (D1, D2); at every discharge – spent water from Bld. 150.
Activity of ^{89}Sr, ^{90}Sr	Monthly: water, discharged by reactor and turbine compartments.
Total α activity	Monthly: water, discharged from Bld. 150

Table 9.3-2 Summary of the radiation monitoring of the INPP aquatic environment.

RADIATION MONITORING OF AQUATIC ENVIRONMENT	
Activity of γ nuclides	20 times a month (on working days) – discharge of technical water and water of intake channel; once in 10 days – sewage water, water of industrial site PLK-1,2, PLK-3, PLK-SFSF; once a month – water from channel surrounding landfill of industrial waste, drainage water of the INPP industrial site; once per quarter (in January, April, July, October) – water of heating networks; twice a year (in spring, autumn) – water of surveillance boreholes in the industrial site and area of SFSF; four times a year (in February, May, August, November) – potable water from water supply (watering-place), potable water from wells in Tilze and Gaide; once a year (in summer) – water of Lake Druksiai; once a year (in winter) – snow at points of permanent surveillance, sampling points of precipitation of industrial site and SFSF site.
Activity of ^{90}Sr	Twice a year (in spring, autumn) – discharge of technical water and water of intake channel, sewage water, water of surveillance boreholes in the industrial site and area of SFSF; once a year (in summer) – water of Lake Druksiai; annually (in winter) – water of heating networks, water from channel surrounding landfill of industrial waste, snow at points of permanent surveillance, sampling points of precipitation of industrial site and SFSF site, water of industrial site PLK-1,2, PLK-3, PLK-SFSF, drainage water of INPP industrial site.
Activity of Pu isotopes	Twice a year (in spring, autumn) – discharge of technical water and water of intake channel.
Activity of ^{3}H	Monthly – discharge of technical water, sewage water, sampling points of precipitation of industrial site and SFSF site, water of industrial site PLK-1,2, PLK-3, PLK-SFSF; once a quarter – water from channel surrounding landfill of industrial waste; twice a year (in spring, autumn) – water of surveillance boreholes in the industrial site and area of SFSF; four times a year (in February, May, August, November) – potable water from wells in Tilze and Gaide.
Total α activity	Four times a year (in February, May, August, November) – potable water from water supply (watering-place), potable water from wells in Tilze and Gaide.
Total β activity	Four times a year (in February, May, August, November) – potable water from water supply (watering-place), potable water from wells in Tilze and Gaide.

Information on the monitoring of the radioactivity in waste waters is also given in this report in Section 7.1.1.5.

9.3.1.2 Monitoring of the radioactive loads to the environment and people

Minimal detectable activities

Minimal detectable activities for the different samples are given in Table 9.3-3. If not mentioned differently, values are given for the case of Cesium-137 activity measurement typical for each kind of samples, sampling preparation and geometry. Cesium-137 is the most significant synthetic radioactive substance existing for instance in food and mainly originates from the Chernobyl NPP accident.

Spectrum completion time span is no less than 12 hours. Determination error is about 100 % during measurement at the sensitivity level of the method, while if measuring activities consist of 10 and more minimal detectable activities, the error goes down to 30 %.

Table 9.3-3. Minimal detectable radioactivities in the environmental samples.

No.	Sample type	Minimal detectable activity
1	Atmospheric air	$1.5 \cdot 10^{-6}$ Bq/m^3
2	Water.Tritium measurement.	3 Bq/l
3	Water	$1 \cdot 10^{-3} \div 0.5$ Bq/l *
4	Fish	3 Bq/kg
5	Soil	3 Bq/kg
6	Bottom sediments	3 Bq/kg
7	Waterweeds	3 Bq/kg

* - large range is conditioned by the differentiating volumes of samples.

Current monitoring program

The environmental monitoring includes the measurements of the dose rate, external absorbed dose and activities of radionuclides in various components of the environment. The program includes the monitoring of all the environmental exposure pathways that may exhibit long term concentration effects, such as the sediments, silts, algae, mussels and milk.

The measurements of radiation are performed in the sanitary protection zone of the INPP nuclear facility and at some distances from it towards the nearest main settlements, taking into account the location peculiarities of the nuclear facility territory. The samples are taken with a frequency corresponding to the alternation of components of the environment and the quantity of gathered data allows assessing the exposure of the members of the critical groups.

The monitoring is performed applying measurement methods and using devices which allow a sufficient accuracy of measurements of the activities of individual isotopes that can lead to doses higher than 0.005 mSv/y.

The Environment Protection Agency of the Ministry of Environment, according to the State Environmental Monitoring Program, performs radiological monitoring of gamma dose rate, air aerosols, precipitation, surface water and bottom sediments in rivers, lakes, the Baltic Sea and the Curonian Bay.

Cooperating with the Ministry of Natural Resources and Environmental Protection of Belarus, samples are taken annually in the presence of the Environment Protection Agency, the Ignalina NPP and Belarusian specialists.

Monitoring of the radioactive loads to the environment and people is described in general in the following paragraphs. The locations of the sampling points, the periodicity of analyses and the sample analytical techniques are determined more exactly in the INPP Environmental Monitoring Program (*INPP Code PTOed-0410-3V2*).

External radiation and airborne radioactive particles

Air radiation monitoring in the INPP area is performed by means of air suction. Seven observation stations are arranged in the INPP sanitary protective area and radiation control area for air sampling. The periodicity of the filter replacement is three times a month. The observation stations are located in the vicinity of the INPP.

The INPP Environmental Monitoring Program also includes the monitoring of changes of in-situ dose rate in the region. The monitoring is performed with the help of sensors of the system “SkyLink”. Ten sensors are installed in the settlements of the observation zone and twelve sensors are installed in the sanitary protection zone. Thus, radiation monitoring is carried out at the major vitally important objects, including INPP personnel and the people living not far from the INPP.

The Institute of Physics performs continuous collection of aerosol particles. The radioecological monitoring station of the Institute of Physics is located at 3.5 km to the south of the Ignalina NPP. The station was founded in 1978. Releases from the power plant reach ground surface in the vicinity of the station and the concentration of radionuclides generated at the power plant and emitted via the 150 m high stacks to the atmosphere doubles. The direction of wind in 16 % of cases corresponds to the direction of transfer from the power plant. The location of the monitoring station of the Institute of Physics is presented in Figure 9.3-2.

Figure 9.3-2 Location of the monitoring station of the Institute of Physics.

Aerosol particles at the Institute of Physics monitoring station are collected weekly. The gamma specter of the samples is measured. Shift of concentrations of cosmogeneous, emitted by the Ignalina NPP, and anthropogenic gamma radiation activities in the air are observed. The computer program Interras has been used in order to present the results of measurements conducted in one figure. The program allows calculation of exposure doses on the basis of measured concentrations of activities of radionuclides in the air. Annual doses of cosmogeneous radiation ^{7}Be have been calculated collectively after exploded nuclear loads in China (1980, 1982). Annual doses of radionuclide radiation (^{137}Cs) from the Chernobyl accident and annual doses of radiation of radionuclides (^{60}Co, ^{54}Mn) emitted by the Ignalina NPP are also calculated.

Aerosol samples are also continuously collected in Utena. Shifting of volumetric activity of cosmogeneous and anthropogenic gamma radiation is monitored.

Concentration of gamma-radiating radionuclides is determined by intensity of the typical gamma-quantum with the use of semiconductor gamma spectrometry method. Indices of separate radionuclide doses Bq/Sv enable calculation of general radiation dose. Beta-radiating radionuclides are measured by the scintillation spectrometry method.

The effective exposure dose is measured using thermo-luminescent dosimeters and portable devices. Thermoluminescent dosimeters are located in the sanitary protective area and radiation control area in different directions and at different distances from INPP (Figure 9.3-3). Exposure time of thermo-luminescent dosimeters is one year.

Lithuanian Hygiene Standard HN 87:2002 "Radiation Protection in Nuclear Installations" (*State Journal, 2003, No. 15-624*) requires that the annual effective dose to the critical group members due to operation and decommissioning of a nuclear facility shall not exceed dose constraint – 0.2 mSv/year. Different release routes (e.g. to the environment through air or water) can lead to doses for the same or different critical group members. Therefore the dose constraint value used for each route should be one half of the actual dose constraint (i.e. 0.1 mSv per year) (*LAND 42-2007*).

The part of radionuclides, which are transferred 8 km with the wind direction from the Ignalina NPP toward Visaginas, is assessed to make estimations of the dose to the population, i.e. to the inhabitants of Visaginas. Precise dose assessment results for critical groups of the population are also obtained through the automated registration of radiation of radionuclides in the surface air and in the nuclear power plant stack releases and a system for calculation of radionuclide transfer in the air (ASKRO). Each hour is summed up for the annual distribution of the calculated dose.

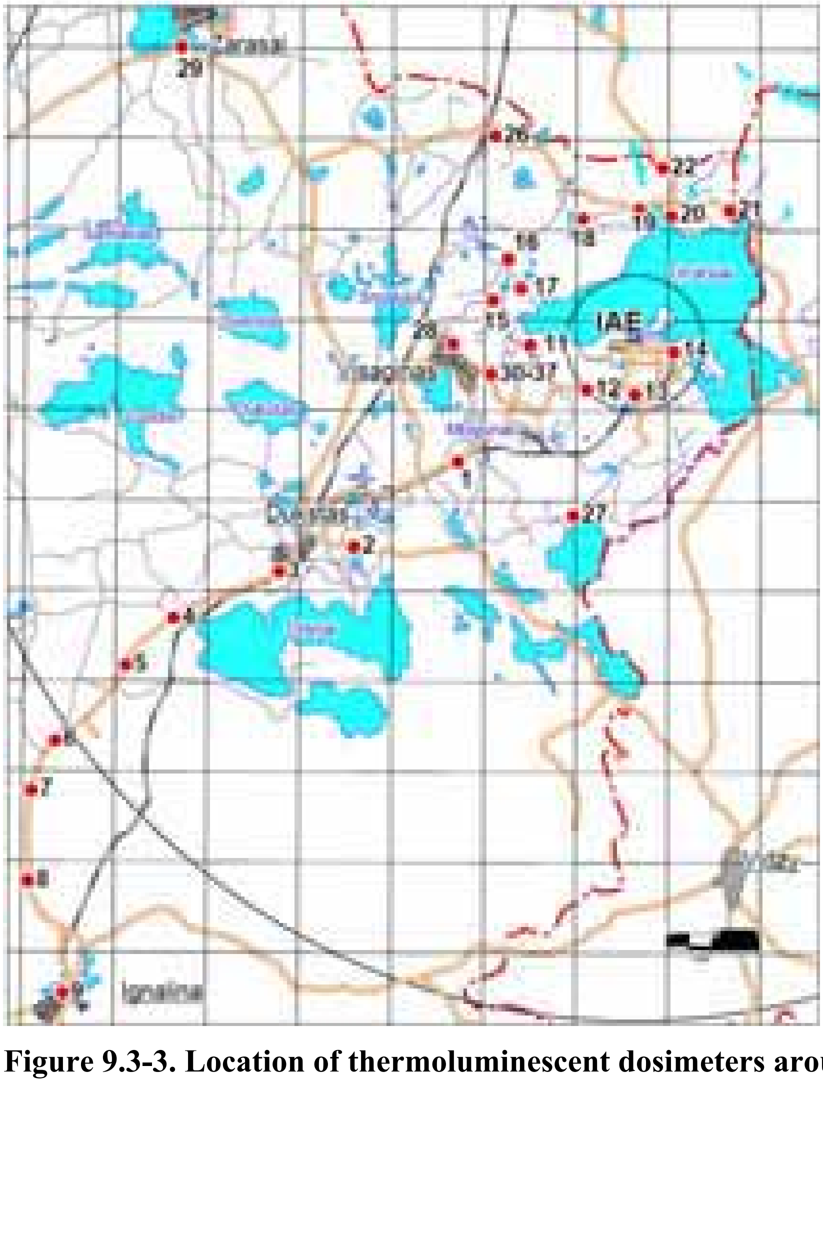

Figure 9.3-3. Location of thermoluminescent dosimeters around the INPP.

Deposition

Atmospheric deposition is continuously collected at five stations (Vilnius, Kaunas, Klaipeda, Utena and Dukstas). Collective beta activity is measured. Every quarter gamma specter analysis of integrated samples is performed and ^{90}Sr activity is measured.

Soil

Samples of the soil in the region of Ignalina NPP (at 8 points of permanent surveillance and in Grikeniskiu peninsula) are monitored annually (in autumn). Activity of γ nuclides, ^{90}Sr and total β activity are measured in the samples of the soil. Location of permanent surveillance points are shown in Figure 9.3-4.

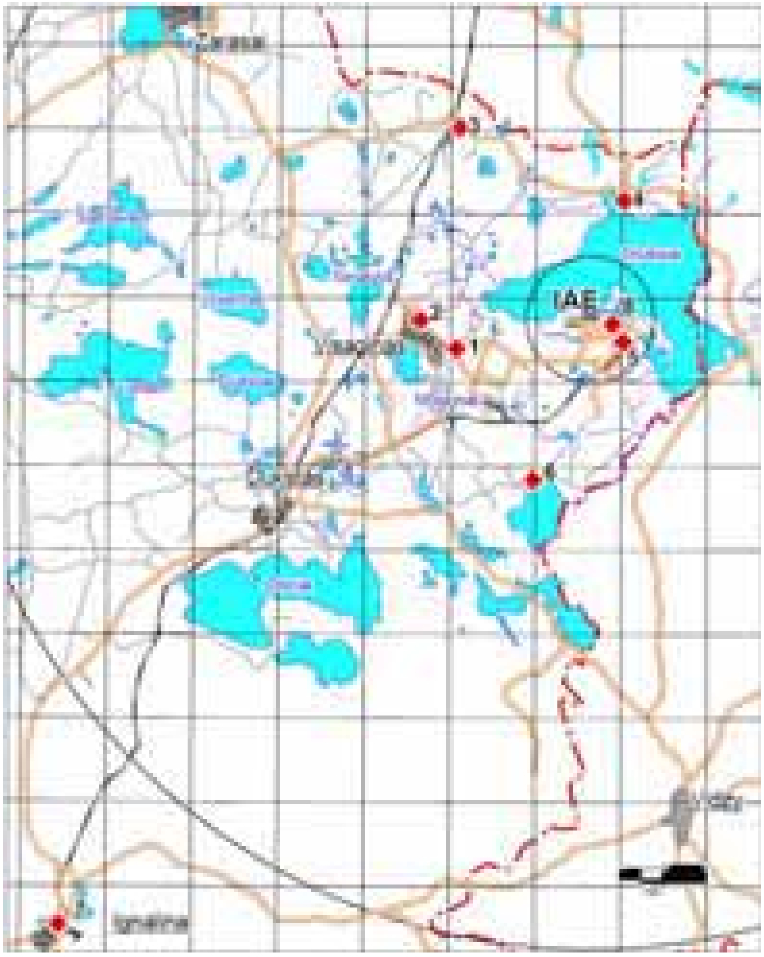

Figure 9.3-4. Location of permanent surveillance points in the INPP region.

Aquatic environment

Samples of surface water are taken every quarter. Samples of discharge of technical water and water of the inlet channel of Lake Druksiai are taken 20 times per month (on working days). Volumetric activities of ^{137}Cs and other gamma radiation and ^{90}Sr are determined. Samples of bottom sediments are taken 2–4 times per year, and specific activities of ^{137}Cs and other gamma nuclides and ^{90}Sr are measured.

The groundwater monitoring program has been developed in accordance with the normative document "Regulation on Ground Water Monitoring of Economy Entities" (*State Journal, 2003, No. 101-4578*) and approved by the Geological Survey of Lithuania.

The measurements, observation points and groundwater monitoring network related to ^{3}H and ^{14}C activity concentration in the lake environment are described in this report in Section 7.1.1.5.

Terrestrial wild plants and natural products

Samples of mushrooms and moss are monitored annually (in autumn) at the locations Vilaragis, Grikeniskes, Tilze, Gaide and Visaginas. Samples of roe deer meat are monitored annually (in autumn) in the radius of 10 km around the INPP. Grain crops (rye and oats), cabbage and potatoes are monitored annually (in autumn) in Tilze. Milk is monitored monthly in Tilze. Samples of meat (pork, beef) are monitored annually (in autumn) in Tilze and at the location Turmantas.

Grazing grass

Samples of pasture grass in the region of Ignalina NPP (at 8 points of permanent surveillance and in Grikeniskiu peninsula) are monitored monthly (from May to October). Activity of γ nuclides, ^{90}Sr and total β activity are measured in the samples of the pasture grass. The location of permanent surveillance points are shown in Figure 9.3-4.

Food and drinking water

Radiological monitoring of food and drinking water is performed by the Radiation Protection Center (RPC). Samples of milk, meat, fish, vegetables (potatoes, cabbage) have been taken for analysis since 1976 in the Ignalina region, and since 1979 in the Zarasai region. Samples of the food products from Utena and grain samples from the Ignalina and Zarasai regions have been monitored since 1992. In 1998–2000 samples have also been taken in the Svencioniu region.

Since 2002, RPC has executed state radiological monitoring of food products and drinking water based on Recommendations of the European Commission (*2000/473/Euratom*) in accordance with the Order of Ministers of the Environment and Health Protection of the Republic of Lithuania from October 7, 2002 No. 528/490 *(State Journal, 2002, No. 100-4460*). Measurements of specific activities (and volumetric – in milk) of total alpha and beta, ^{90}Sr and ^{137}Cs in samples of food products are performed. Analysis of total alpha and beta (except $^{3}H_1$, ^{14}C, ^{40}K) and tritium volumetric activities are performed in samples of drinking water.

Specific activity of ^{137}Cs is regulated in food. In addition it is recommended to analyze ^{90}Sr in food products during radiological monitoring because it easily penetrates into bone tissue and accumulates in it. Analysis of total alpha and beta activities is also performed in food. According to the Lithuanian Hygiene Standard HN 24:2003 "Requirements on safety and quality of drinking water" (*State Journal, 2007, No. 79-3606*) volumetric activity of tritium and total alpha and beta activity are regulated in drinking water (for evaluation of annual effective dose).

The National veterinary laboratory observes radionuclides in animal products and fodder independently.

9.3.2 Proposals for the monitoring system for the new NPP

The new NPP can start operation only after receiving permission for release of radionuclides to the environment. The permission is issued by the Ministry of Environment. According to the clause 17 of LAND 42-2007, the operating organization of the new NPP shall submit to the Ministry of Environment an application for permission, a plan on releases of radionuclides and a radiological monitoring program confirmed by the Environment Protection Agency, Lithuanian Hydrometeorological Service under the Ministry of Environment and Radiation Protection Centre. According to clause 21 of LAND 42-2007, the permission is issued indefinitely.

The monitoring system for the new NPP will be designed to fulfil all the requirements of the Lithuanian legislation and regulations, the IAEA recommendations and obligations under the United Nations Conventions. The existing INPP monitoring system will be utilized where applicable. However, all the monitoring systems and devices applied will be modernized to meet the current requirements on preciseness and periodicity. The monitoring sites and objects will be kept unaltered when possible to assure the comparability of the existing INPP monitoring data with the new system.

9.3.2.1 Monitoring of radioactive releases

Airborne releases

Accurate release measurements of radioactive substances are used to ensure that the combined releases from the NNPP to the air and water do not exceed the release limits set by the authorities. This also allows the detailed assessment of the activity of the annual airborne and waterborne releases. The releases of radioactive substances from the nuclear power plant and spent fuel repositories originate from the handling and processing systems for waters and gases containing radioactive materials. The monitoring of releases into the air and water will cover all such systems that contain or may contain radioactive materials.

Releases of radioactive materials from the nuclear power plant take place through monitored release routes. Releases into the air are emitted in a centralized manner through the vent stack of the plant and possibly, to a minor extent, through the air conditioning of the turbine building. For the assessment of the radionuclide activities of airborne releases from the new NPP the releases will be monitored by sampling and continuous measurements.

The radionuclides can be divided into three groups: radioactive noble gases, radioactive iodine and radioactive aerosols. Activity will be measured directly or from integral samples given continuously. The flow of discharged gases will be credibly measured at any condition. The radioisotopic content of airborne releases will be assessed and the activity of radionuclides will be measured. The activity of releases in the main physical-chemical forms of ^{3}H will be measured. For the assessment of short-term alternation of the releases from nuclear reactors the total activity of the releases will be measured at least daily (hourly for main flows of releases). Proposals for monitoring of the common gaseous and particle releases of the NPP and examples of the radionuclides in releases and their detectable limits are presented in Table 9.3-4.

Content of radionuclides in releases is determined on the basis of gamma specter measurement of spectrometric aerosol particles and inert gases in samples from the ventilation air stacks, and this allows evaluation of penetration of every radionuclide to the surface air. Since radionuclides may be released from the power plant to the ambient air via ventilation stacks of reactor units and via ventilation tubing of the rooms with the radioactive waste treatment equipment, calculations will be performed for three different height cases. The ventilation air stacks of the new NPP will have a set of sampling equipment through which part of the exhausted gases travel. The equipment will be based on the most effective and advanced techniques that can be practically adopted. The solid particles contained in the sample flow are caught in the sampling filter that is changed and analysed regularly. The level of radioactivity of gaseous substances is measured using a continuously operating radioactivity meter. Samples will also be taken of the gas at regular intervals for isotope-specific analysis.

The system RADIS has been used in the Ignalina NPP. It will be assessed whether the same system is also adequate for the new NPP or whether there will be a need for modernization of the system.

Table 9.3-4 Proposals for monitoring of the common gaseous and particle releases of the NNPP and examples of the radionuclides in releases and their detectable limits (*Edilex 2008*).

Release	Monitoring method	Reduplication	Radionuclide	Minimal detectable activity in release flow
Noble gases	continuous monitoring	yes	^{133}Xe	10 kBq/m³ during monitoring < 10 min
	laboratory determination at minimum weekly	yes	^{85}Kr	10 kBq/m³
			^{87}Kr	1 kBq/m³
			^{133}Xe	1 kBq/m³
Iodines	continuous monitoring		^{131}I	2 Bq/m³ during monitoring < 1 h
	laboratory determination at minimum weekly	yes	^{131}I	4 mBq/m³
Aerosols	continuous monitoring		all	4 Bq/m³ during monitoring < 1 h
	laboratory determination at minimum weekly	yes	^{60}Co	1 mBq/m³
			^{137}Cs	1 mBq/m³
Alpha activity	laboratory determination at minimum monthly	yes	all	total activity 1 mBq/m³
			^{241}Am	0.1 mBq/m³
Significant single nuclides	laboratory determination at every quarter	yes	^{89}Sr and ^{90}Sr	combined activity 0,1 mBq/m³
	laboratory determination at minimum monthly		^{3}H	0,1 kBq/m³
	laboratory determination at minimum monthly		^{14}C	10 Bq/m³

Waterborne releases

A similar sampling procedure as for airborne releases will also be used to monitor the radioactivity of waste waters discharged from the plant to Lake Druksiai. The radioisotopic content of waterborne discharges and the activity of radionuclides will be assessed. Stationary systems for the direct measurement or sampling of integral samples will be installed at the main pathways of permanent discharges. Automatic systems will be installed when reasonable. The total activities of the waterborne releases at the main pathways will be assessed at least daily. At less important pathways sampling will be performed regularly. The flows of waterborne discharges will be credibly measured in all pathways at any condition. Proposals for monitoring of the common liquid releases and examples of the detectable limits of the monitors are presented in Table 9.3-5.

Monitoring measurements of radioactivity in household waste water at the Ignalina NPP are performed at the waste water collection point (on the NPP site), at the waste water receiving point (at Lake Druksiai) and halfway down a stream between the waste water treatment plant and Lake Druksiai. Radioactivity is also monitored in five discharge points and six stations in Lake Druksiai (see Figure 9.3-1). It will be assessed whether the same monitoring points could be used also for the new NPP. However all waste waters from the monitored area will be treated in the liquid waste water treatment plant. From the treatment plant the waste water will be collected to specific discharge containers where the monitoring of the radioactivity releases of aqueous waste will be performed. The plant laboratory will measure the level of radioactivity in the water and clear it for pumping out if the level is acceptably low. If the radioactivity level of the water is not low enough it will be returned for further treatment. In conjunction with discharging the water into the lake, a collective sample will be taken for release measurements. There will be an automatically operating unit of measurement based on best available techniques in the discharge tube. There will also be valves which are closed automatically in cases when discharged water activity level is too high. In addition the auxiliary plants such as the repository for operating waste and the spent fuel storage will be included into the power plant's release control.

The systems designed to monitor the release of radioactive materials will have means for calibration and operability testing.

Table 9.3-5 Proposals for monitoring of the common liquid releases and examples of the detectable limits of the monitors (*Edilex 2008*).

Release	Monitoring method	Reduplication	Radionuclide	Minimal detectable activity in release flow
Gamma activity	continuous monitoring	yes or verification by sampling	significant	detection limits notably lower than the maximum limit set for the gamma activity, e.g. 400 kBq/m³
	release-specific laboratory determination		significant	1 kBq/m³
Alpha activity	laboratory determination monthly		all	total activity 1 kBq/m³
			^{241}Am	10 Bq/m³
Significant single nuclides	laboratory determination at every quarter		^{89}Sr ja ^{90}Sr	combined activity 0,2 kBq/m³
	laboratory determination monthly		^{3}H	50 kBq/m³

Additional monitoring

The activity of ^{14}C in airborne and waterborne releases will be systematically measured or assessed by calculations, which will be validated using the measurements performed under various modes of nuclear object operation. The activity of the radionuclides in airborne and waterborne releases will be credibly assessed during short-term increase of releases. If an increase of releases is foreseen (e.g. during start-up or shutdown of the NNPP), an additional observation shall be performed. Accordingly stationary observation systems or the application of laboratory methods will be used.

9.3.2.2 Monitoring of the radioactive loads to the environment and people

The purpose of environmental radiation monitoring is to determine the radiation load caused to the environment and people by the radioactive releases from the nuclear power plant. The radiation measurements of the power plant area and surroundings ensure that the radiation dose limits set by the authorities are not exceeded. Radiation monitoring also confirms the measurement results of the power plant's radioactive releases and detects any short-term and long-term changes in the normal radiation situation of the surroundings. The radiation monitoring program contains e.g. external radiation measurement and analyses of activity in inhaled air and in samples representing different phases of the food chains leading to humans.

A radiological monitoring program for the new NPP will cover monitoring of all environment radiation ways, capable of impacting people and environment. According to clause 42 of LAND 42-2007, the monitoring program of the new NPP and its amendments will be confirmed by the Ministry of Environment, Environment Protection Agency, Lithuanian Hydrometeorological Service under the Ministry of Environment and Radiation Protection Centre. According to clause 38 of LAND 42-2007, monitoring shall be performed at least one year before the start of operation of the new NPP. The first revision of the radiological monitoring program shall be performed after one year of operation of the new NPP and then after every five years.

The environmental monitoring will include the measurements of the dose rate, external absorbed dose and activities of radionuclides in various components of the environment. Continuous measurements of radiation will be performed in the sanitary protection zone of the NNPP and at some distances from it towards the nearest main settlements, taking into account the location peculiarities of the NNPP territory. All the devices for dose rate measurements and for the measurements of the external absorbed dose will represent best available techniques. Samples of environmental indicators will be taken in the sanitary protection and monitoring zones at locations where pollutants are released or discharged and where the maximal pollution (according to assessments of radionuclides dispersion and territory peculiarities) is expected.

The samples will be taken with a frequency corresponding to the alternation of components of the environment and the quantity of gathered data will be such that it allows assessment of the exposure of the members of the critical group (groups). For the assessment of the pollution of environmental indicators the radio isotopic content of samples will be estimated, and the concentrations of the gamma emitters (^{137}Cs, ^{134}Cs, ^{60}Co, ^{54}Mn, ^{95}Zr, ^{95}Nb, ^{131}I etc.) will be measured. The pollution with beta emitters (^{89}Sr, ^{90}Sr, ^{3}H and ^{14}C) and alpha emitters ($^{239,\ 240}$Pu) will be assessed using the analysis of chosen archetypal samples. Performing the measurements of the concentration of beta and alpha emitters the methods of chemical seduction of elements will be applied, if necessary. If it is known or supposed that the activities or content of airborne and waterborne releases can change, the samples will be taken more frequently, and additional measurements will be performed.

The monitoring will be performed applying measurement methods and using devices which allow measuring the activities of individual isotopes that can lead to doses higher than 0.005 mSv/y with sufficient accuracy. The monitoring systems will be doubled and operated continuously, which allows assessing the concentrations of any period and comparing with the maximum permissible concentrations. For the data quality assurance the monitoring systems will be installed, tested, calibrated, operated and renovated in accordance with the nuclear industry standards and the quality assurance program.

A proposal for a program for monitoring radionuclides of the new NPP is presented in Table 9.3-6.

External radiation

External radiation will be measured continuously. All the monitoring equipment and stations will be used and located by utilizing existing sites and devices wherever reasonable (e.g. sensors of the SkyLink System). All decisions should however be based on the best available techniques. Continuously operating environmental dose rate meters and thermoluminescent dosimeter stations located at 0–10 km from the NNPP will be used for continuous measuring and recording. Some meters will also be connected to the nationwide radiation monitoring network through which the readings will be available in real-time. In addition there will be supplementary gamma-spectrometric measurements once every two years.

Airborne radioactive particles and iodine

The radiation monitoring program will also cover samples taken in various locations and during all seasons. The samples will be taken from indicator organisms which gather or enrich the radioactive substances contained in the releases. Air and the particles contained in it will also be monitored using continuous sampling. Monitoring of airborne radioactive particles and iodine in the new NPP area will be performed by high-volume air sample collectors. Existing observation stations will be used when reasonable. Air samples will be collected continuously and simultaneously. All the devices including the filters used in collectors will represent best available techniques. The filters will be changed a few times per month, but during maintenance and refuelling outages of the power plants, filters from the sampler closest to the power plant will be changed weekly. A portable air sample collector will be used when needed for complementary monitoring, e.g. once a week during refuelling.

Deposition

Deposition will be measured continuously in rain water. Deposition collectors (rain sample collectors) for dry and wet deposition will be located at distances of 1–10 kilometers from the power plant. Electric warming will be used to prevent freezing and for melting the snow deposited in the collector in winter. The sample vessels will be changed regularly. *(STUK-A227, 2008, p. 27)*

Soil samples

Before the start of operation of the new NPP the environmental geological investigations should be carried out and possible ambient pollution should be evaluated.

During operation of the new NPP samples will be taken from the area of assumed maximum deposition to determine the accumulation of long-lived radionuclides. Samples will be drawn from 8 standard points twice a year. Possibly polluted soil will be changed mechanically to clean. Polluted soil will be treated in situ using specific physical processes (electrolysis, etc.) or materials (sorbents).

Grazing grass

Samples will also be taken of grazing grass twice per growing season at distances of 0–10 km from the new NPP. Grazing grass is taken as a collective sample representing farms producing milk.

Terrestrial wild plants, natural products and game

Samples will also be taken of terrestrial wild plants such as moss, natural products (e.g. mushrooms and berries) and game (roe deer meat) at minimum in three ecological sites.

An attempt will be to gather the samples from an area which is as small and uniform as possible. Samples are taken annually during the growth season and in the vicinity of the power plant. Samples of wild berries and mushrooms growing in the vicinities of the NPP will be taken simultaneously with the soil sampling.

Other food

Samples will be taken e.g. of milk, potatoes, cabbage, grains and meat. The sources of the samples will be chosen so that they provide comprehensive coverage of the routes through which people may receive radioactive substances in food. The samples are taken at distances ranging from 0 to 40 kilometres from the power plant. Milk samples will be taken once a week by the personnel of local dairies operating in the regions of the power plants. The samples representing the whole production of the local dairy could be taken from collection tanks in the dairy according to standard methods used in sampling of food supplies. Samples of potatoes and cabbage will be taken from a chosen garden grown at 0–10 km from the NPP as for normal household use. Grain samples of rye and oats will be taken once a year in local grain stores grown at less than 20 km from the NPP. Meat samples (pork and beef) will be taken twice a year from livestock raised at less than 40 km from the NPP. Beef samples will be taken in a central slaughterhouse from cows of varied ages in the same ratio as they are delivered for slaughter. (*STUK-A227, 2008, p. 33-35*)

Drinking water

Samples of drinking water will be taken 2–4 times a year directly from the network of water pipes or from raw water reservoirs.

Surrounding residents

The internal radioactivity measurements of the nearby residents ensure that there are no significant, unrecognised exposure pathways for the residents of the surroundings. Measurements will be taken of 8–15 residents. Radioactive emissions from the new NPP and caused annual doses to population will be summarized in the monitoring program.

Lake environment

In the lake environment samples of water are taken in the surrounding area of the new NPP 4 times a year, samples of aquatic indicator organisms and bottom sediments twice a year in six stations. The fish samples will consist of 2–4 economically important species from the discharge area and from a comparison area.

Table 9.3-6 Proposal for a program for monitoring radionuclides of the new NPP (adapting *STUK-A227, 2008, p. 14–17*).

Monitoring object	Type of measurements or samples and number of measurements or sampling stations	Measuring or sampling frequency	Analyses and frequencies
External radiation	Environmental dose rate meters at 0-10 km from the power plant	Continuous measurement and recording	Dose rate, min., max., mean, analogue plotter charts and/or digital hourly average values
	TLD dosemeter stations at 0–10 km from the power plant	Continuous measurement	Gamma dose, 4 times a year
	Supplementary gamma-spectrometric measurements	Once every two years	Gamma spectrum, once every two years
Airborne radioactive particles and iodine	Air sample collectors at 0–10 km from the power plant	Continuous collection	Gamma emitters, twice a month (once a week)
	Supplementary monitoring performed with a portable air sample collector	Once a week during refuelling	Gamma emitters, once a week during refuelling
Deposition	Deposition collectors at 0–10 km from the power plant	Continuous collection	Gamma emitters, and ^{3}H, 4–12 times a year, ^{89}Sr and ^{90}Sr, 4 times a year
Soil	Soil samples are drawn from the area of assumed maximum deposition to determine the accumulation of long-lived radionuclides	Once every four years	Gamma emitters and ^{90}Sr, vertical distribution
Terrestrial wild plants, natural products and game	Wild berries and mushrooms	Simultaneously with the soil sampling	Gamma emitters
	Roe deer meat from one sampling site close to the power plant	Once a year	Gamma emitters, once a year
	E.g. moss from one sampling site close to the power plant	Once a year after the refuelling	Gamma emitters, once a year
Grazing grass	Collective sample representing farms producing milk at 0–10 km from the power plant	Twice a growing season	Gamma emitters, twice a growing season
Milk	Sample representing farms producing milk at 0–10 km from the power plant	Once a week	^{131}I and gamma emitters, once a month
	Sample representing the whole production of the local dairy	Once a week	Gamma emitters once a month and ^{131}I if needed; ^{89}Sr, ^{90}Sr six times a year
Garden produce	Potatoes grown at 0–10 km from the power plant	Twice a growing season	Gamma emitters, twice a year
	Cabbage grown at 0–10 km from the power plant	Twice a growing season	Gamma emitters, twice a year
Grain	Samples of rye and oats grown at less than 20 km from the power plant	Once a year	Gamma emitters, once a year
Meat	Beef and pork samples from livestock raised at less than 40 km from the power plant	Twice a year	Gamma emitters, twice a year
Drinking water	Samples of drinking water or raw water from the power plant and from the nearby town	2–4 times a year	Gamma emitters, and ^{3}H, 2–4 times a year, ^{89}Sr and ^{90}Sr, twice a year
Lake water	Samples from 6 stations in the surrounding lake areas of the power plant	2–4 times a year	Gamma emitters, ^{3}H, ^{89}Sr and ^{90}Sr, 2–4 times a year
Bottom sediments	Sinking matter collected by sediment traps at stations in the surrounding lake areas	Continuous collection	Gamma emitters, 4 times a year; ^{238}Pu and $^{239,240}Pu$, once a year
	Sediment samples are taken from several stations in the surrounding lake areas	Once every four years	Gamma emitters, ^{90}Sr, ^{238}Pu and $^{239,240}Pu$, vertical distribution
Aquatic indicator organisms	E.g. periphyton collected by $1 m^2$ sampling plates close to the cooling water outlets of the power plant	Continuous collection during the growing season	Gamma emitters, 4 times a growing season
Wild fish	E.g. pike from two sampling areas	Twice a year	Gamma emitters, twice a year, ^{89}Sr and ^{90}Sr

9.4 OTHER MONITORING

9.4.1 Current monitoring system

9.4.1.1 Seismic alarm monitoring system

The Lithuanian territory is traditionally considered as non-seismic or low seismic zone. However historical and recent data shows that seismic events of low or medium intensity have happened in territories of the Baltic States. Four seismological observation stations have been installed in the INPP region. The data gathered in the stations is processed and analysed according to the State Nuclear Power Safety Inspectorate (VATESI) regulation P-2006-01 “Requirements for Analysis of Seismic Impact on Nuclear Installations” (*State Journal, 2006, No. 87-3447*) and the IAEA Safety Standards.

The seismic alarm monitoring system comprises sensors located at distances of up to 30 km from the plant permitting alerting prior to arrival of earthquake shock waves at the site. It identifies seismic events larger than design earthquakes, does not interfere with other systems and its integration does not involve any risk for the plant supplier.

9.4.1.2 Monitoring of cooling and waste waters

Cooling water

Monitoring of thermal effects of the INNP cooling water is carried out according to the regulations “Standard Limits of Permissible Warming of Lake Druksiai Water and Methodology for Temperature Control” (*LAND 7-95/M-02*) and the Ignalina NPP Environmental Monitoring Program. A description of the content of the regulations can be found from the Section 7.1.1.5 “Water temperature monitoring of Lake Druksiai”.

Waste water

The quality of waste waters is monitored according to the “Regulation on Sewage Management” (*State Journal, 2007, No. 110-4522*) and the Ignalina NPP Integrated Pollution Prevention and Control Permission (*No. TV(2)-3, issued by Utena Regional Environment Protection Department*). Household wastewater treatment is outsourced to the State Enterprise “Visagino Energija”, which operates the Visaginas waste water treatment plant; hence the monitoring of household waste waters is carried out by “Visagino Energija”.

In addition the waste water monitoring comprises the follow up of regeneration effluents (from process water production) and discharges from the rain water disposal system. Rain water is managed according to the requirements of “Regulation on Surface Water Management” (*State Journal, 2007, No. 42-1594*). The monitoring is carried out in the cooling water discharge channel, in the inlet channel and in the rain-industrial water release channels 1,2 (PLK-1,2), 3 (PLK-3) and in the release channel of the Spent Fuel Storage Facility (PLK-SFSF).

9.4.1.3 Monitoring of the environmental impacts

Historically the monitoring of the environmental impacts was part of the various State financed scientific programs (1978–2007) which comprised both radioecological and non-radioecological monitoring. A summary of monitoring results of the aquatic ecosystem (physico-chemical parameters, plankton, aquatic vegetation, fish stocks and fishing activity) is presented in Section 7.1.1.4. Summaries of monitoring results of the radionuclides in the water of Lake Druksiai and groundwater are presented in Section 7.1.1.5, the radioecological state of flora and fauna of Lake Druksiai in Section 7.1.1.6, the ecotoxicological state of Lake Druksiai in Section 7.1.1.7 and the radioecological state of terrestrial flora, fauna and onshore land of the region in Section 7.6 of this EIA Report.

More detailed scientific monitoring data can be found in the State Scientific Program "Atomic Energy and the Environment" (*Collection of Research Reports, 1993–1997, Vol. 1–5*) and in the report of the project recently performed by Radiation Protection Center together with various research institutitions (*Radiation Protection Centre Project Report, 2007*).

9.4.1.4 Monitoring of flue gas emissions

Total emission values are calculated based on fuel consumption. The impact of flue gases on air quality can be assessed based on data from the monitoring station in Aukstaitija (see Section 7.2 Background contamination of the ambient air and greenhouse gases).

9.4.1.5 Noise monitoring

Noise levels caused by the INPP are not monitored at regular intervals.

9.4.1.6 Monitoring of social impacts

A program for the socio-economic monitoring of the INPP region was compiled and prepared by the Division of Regional Geography of Institute of Geology and Geography in 2002 (*R. Baubinas et al., 2002*). Preparation of the program was funded by the United Nations Development Program and coordinated by the Ministry for Social Security and Labor. The monitoring has been organized in the context of preparations for the closure of the INPP. The objective has been to diminish the possible negative impacts of the closure of the INPP and to increase the effectiveness of social policy measures.

More information on the social processes taking place in the region, their interdependence and dependence on the processes outside the region is presented in Section 7.9 of this EIA Report.

9.4.2 Proposals for the monitoring system for the new NPP

The monitoring system for the new NPP will be designed to fulfil all the requirements of the Lithuanian legislation and regulations, the IAEA recommendations and obligations under the United Nations Conventions. The existing INPP monitoring system will be utilized where applicable. However, all the monitoring systems and devices applied will be modernized to meet the current requirements on preciseness and periodicity. The monitoring sites and objects will be kept unaltered when possible to assure the comparability of the existing INPP monitoring data with the new system.

9.4.2.1 Seismic alarm monitoring system

The existing seismic alarm system has been installed in 1999 in the vicinity of the INNP. The system will be utilized also for the new NPP. The new NPP, however, will be designed and constructed to prevent the risks of possible seismic activities.

All the devices used in the alarm system will be modernized if necessary to meet the current national and international requirements.

9.4.2.2 Monitoring of cooling and waste waters

Cooling water

Monitoring of the cooling water comprises the amount, temperature and quality of the discharged water.

The amount of the cooling water will be followed based on the operation data of the new NPP and the output of cooling water pumps.

Temperature monitoring will be carried out by a continuous temperature measurement system which will be installed at the new NPP. Monitoring will be performed with automatic temperature monitoring devices which send the data directly to a defined receiver. The temperature of inflow and outflow water (sample stations within the inlet and outlet channels) will be monitored continuously with real-time monitoring devices. The results will be saved to a computer system as hourly and daily averages. Also thermal and electrical usage data of the new NPP operation will be continuously saved in the computer system. The measurements are used in calculations of the temperature rise in condensers and in computing the flow rate of cooling water. Also the amount of thermal energy directed to Lake Druksiai will be calculated based on the measurements.

The thermal effects of the cooling water discharges are monitored in Lake Druksiai. Continuous temperature monitoring with automatic devices will include 2-4 sampling stations. The location of the sample stations will be defined based on representativeness. The same sample stations as in INPP monitoring will be used when applicable.

Monitoring of the quality of the cooling water is described in the following paragraph “Waste water”.

Waste water

The quality of the sanitary waste waters will be monitored by the Visaginas waste water treatment plant (WWTP). The WWTP performs monitoring of waste water discharge quality and amount as it is responsible for the water quality discharged to the environment. A reconstruction project of the plant was started May 2008 and the new plant will be able to meet the current Lithuanian (Regulation on Sewage Management; *State Journal, 2007, No. 110-4522),* Regulation on Surface Water Management; *State Journal, 2007, No. 42-1594*)and EU effluent standards (*Council Directive 91/271/EEC concerning urban waste-water treatment*).

The monitoring will follow the Lithuanian legislation and regulations and protocols required by the urban waste water treatment directive. Flow-proportional or time-based 24-hour samples will be collected at the same well-defined point in the outlet and if necessary in the inlet. The minimum annual number of samples will be 12, which will be collected at regular intervals during the year. Monitoring will comprise at least the following parameters: $BOD_{5/7}$, COD, total suspended solids, total phosphorus and total nitrogen. The monitoring program may comprise also other parameters, such as pH, nitrites, nitrates or phosphates, if considered reasonable. The quality requirements (concentrations/ percentage of reduction) are presented in Section 7.1 “The state of waters”.

The pH in the neutralization basin will be measured with an automatic device before discharging to the cooling water channel. The quality of cooling water discharged will be monitored every 10 days. The monitored parameters will include at least the following: pH, N_{tot}, NH_4-N, NO_2-N/NO_3-N, P_{tot}, $BOD_{5/7}$, TDS, TSS, sulphates and chlorides. In case pesticides are used, they will be included in the monitoring program. Other parameters should be considered when reasonable.

All the waters from the rain water disposal system will be collected and continuously followed in inspection wells and settling basins. Oil detector devices, which automatically alarm when oil is detected, will be installed. Detected oil will be removed in oil separators before discharging to the lake. The quality of discharged water will be monitored every 10 days. The monitored parameters will include at least the following: pH, N_{tot}, NH_4-N, NO_2-N/NO_3-N, P_{tot}, $BOD_{5/7}$, TDS and TSS.

Good sampling and laboratory practices (based on international standards) will be applied.

9.4.2.3 Monitoring of the environmental impacts

Monitoring of the environmental impacts will be included in the monitoring program. A detailed monitoring plan will be established together with the authorities but it can comprise e.g. the following indicators; physico-chemical water quality, primary production (chlorophyll-a), aquatic vegetation and fish stock. A proposal for parameters and frequencies of monitoring is presented below.

The physico-chemical water quality in Lake Druksiai will be monitored 3–12 times of year at 2–5 sampling stations. It will comprise at least monitoring of pH, O_2/l, O_2%, N_{tot}, NH_4-N, NO_2-N/NO_3-N, P_{tot}, $BOD_{5/7}$ and TDS. Also other parameters should be considered when reasonable.

Monitoring of the primary production can be based either solely on the cholorophyll-a measurements or combination of it and phytoplankton samples. It should be carried out regularly (2–6 times/ month) at several sample stations (2–5) during the growing season.

The composition and abundance of aquatic vegetation will be monitored every 3–6 year during the growing season at several sample stations (2–5).

Monitoring of the fish stock will be carried out with an interval of 1 to 4 years. The composition and abundance of fish will be monitored by gillnetting (standard gillnets) both in the pelagic and littoral zone (at 2–5 sample stations). Also other methods (such as hydroacoustics or trawling) can be applied.

The existing sample stations will be kept unaltered when possible. All the methods applied in sampling and analyzing the samples will be based on national/international standards to ensure the comparability of the results.

9.4.2.4 Monitoring of flue gas emissions

Flue gas emissions will be calculated based on fuel consumption as it has been done for the INPP. Air quality will be monitored at the integrated monitoring stations as recently.

9.4.2.5 Noise monitoring

During construction of the NNPP noise measurements will be carried out if necessary.

During operation of the new NPP noise will be measured at regular intervals in order to ensure that noise levels from the power plant complies with the levels set in the regulations.

If necessary, the noise level in open air will be measured at locations in which such noise is perceived most clearly.

9.4.2.6 Keeping records of the waste

Keeping records of different types of waste arising at the NNPP will be carried out.

9.4.2.7 Monitoring of social impacts

The methods and results of existing socio-economic monitoring of the INPP will be utilized where applicable for the new NPP.

Cooperation with interest groups is an important part of the normal operations of any modern, social responsible company. The opinions of people living in the area could be studied by queries and be used to support the assessment of the social impacts of the project. The assessment of health impacts is also part of the assessment of the project's social impacts.

Useful information on the negative impacts of the project and on the means available for mitigating or preventing them can be obtained through open exchange of information with interest groups. The connections established during the environmental impact assessment procedure can serve as channels for interaction in the future.

The operator will organise regular meetings with representatives of neighbouring areas and the existing information centre of the INPP can offer information on the new NPP (tours, the information bulletin, the news sheet, booklets, calendars, magazines etc.).

Indirect and direct impacts of the project on employment and businesses could also be studied.

9.5 MONITORING DATA REPORTING

The data concerning monthly monitoring of air and water effluents will be submitted to the Ministry of Environment, the Radiation Protection Centre and VATESI at the first week of the following month (except data on ^{3}H, which will be submitted every three months). An annual report on the results of environmental monitoring will be submitted to the Ministry of Environment, the Environment Protection Agency, VATESI, the Radiation Protection Center and the Local Authorities before first of April of the following year. In accordance with clause 68 of LAND 42-2007, the report will include information as follows:

- results of all measurements foreseen in the Monitoring Program and their analysis;
- activities of radionuclides released into ambient air and water (by months) and total annual activities of radionuclides (given in the list);
- general information concerning realized activities (amount of produced electricity, generated, conditioned, stored or disposed of radioactive waste);
- comparison of radionuclide activities with limits;
- releases and contamination changing trends and their analysis;
- evaluative doses of members of critical groups, caused by radionuclides, their comparison with dose constraint;
- reasons of extraordinary releases of radionuclides into environment and their analysis;
- any other important information.