Consortium
Pöyry Energy Oy
Lithuanian Energy Institute

Environmental Impact Assessment Program

New Nuclear Power Plant in Lithuania

15 November 2007

Organizer of proposed economic activity:	**Lietuvos Energija AB**
Developer of EIA program:	**Pöyry Energy Oy (Finland)**
	Lithuanian Energy Institute (Lithuania)

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Developer of EIA program:	**Pöyry Energy Oy**	**M. Pohjonen**
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Geological maps by permission of Lithuanian Geological Survey.

EXECUTIVE SUMMARY

Lietuvos Energija AB has initiated an environmental impact assessment procedure (EIA procedure) for investigating the environmental impacts of a new nuclear power plant (NPP) in Lithuania. The power plant would be located in the vicinity of the present Ignalina nuclear power plant. The net electrical output of the new nuclear power plant would be at most 3 400 MW. The present NPP unit 1 of Ignalina NPP has been closed and the unit 2 will be closed at the end of 2009, thus replacement capacity is needed.

Two alternative sites for the power plant unit will be evaluated in the environmental impact assessment. Alternative site 1 is situated east of the unit 2 of the present power plant and alternative site 2 is situated west of the existing switchyard. The alternative locations of the cooling water outlet and inlet channels for the new power plant will be assessed as part of the studies and presented in EIA report. Also a zero-option, the non-implementation of the new NPP in Lithuania, will be considered.

The EIA is carried out in two subsequent stages. In the first phase, the EIA program is prepared and presented to the authorities and public for a review. The EIA program defines the scope and content of the EIA report. It must be approved by the competent authority (Ministry of Environment of Lithuania) before the EIA report can be prepared.

In the second phase, the EIA report will be prepared based on the approved EIA program and motivated (justified) proposals and opinions of the EIA parties, concerned public and foreign countries. It will present information about the project and its alternatives, as well as a coherent assessment of their environmental impacts. Information about existing environmental assessments as well as those carried out during the EIA study will be collected in the EIA report. On the basis of the assessments to be made and other information, the impacts of the project on human beings, fauna and flora; soil, air, surface and groundwater, climate, landscape and biodiversity; material assets and the immovable cultural heritage, and interaction among these factors will be assessed and described in the EIA report. Environmental impacts in case of accidental conditions at the nuclear power plant will also be assessed.

Other important objective of the EIA procedure is to increase openness and accessibility of information of the project and comprise the opportunities for citizens' participation. The developer of the project, Lietuvos Energija AB and Ministry of Environment of Lithuania, shall inform the public about the EIA documents in accordance with requirements of the Order of Informing the Public and the Public Participation in the Process of Environmental Impact Assessment *(State Journal, 2005, No. 93-3472)*. The citizens have the right to examine the documents and give their opinions about them. During the EIA procedure, information and discussion events will be arranged for the general public and the stakeholder group consisting of the main authorities, whom the project may concern. In these events, the citizens will have an opportunity to express their opinions on the EIA work and its adequacy and to receive information about the proposed economic activity and its environmental impacts.

Environmental impact assessment in a transboundary context is regulated by the Lithuanian Law on Assessment of the Impact on the Environment of the Planned Economic Activities and by the United Nations Convention on Environmental Impact Assessment in a Transboundary Context (*Espoo Convention*). The Ministry of Environment is responsible for the practical organization of the environmental assessment procedures in a transboundary context. The Ministry of Environment has informed the respective institutions of Latvia, Estonia, Poland, Belarus, Finland, Sweden and Russia about the commenced environmental assessment process of the new nuclear power plant in Lithuania and it was inquired about their intent to take part in the environmental assessment procedure. The information letter was supplemented by the EIA program in English or Russian and a comprehensive summary in country's official language was attached. The above mentioned countries have an opportunity to present their suggestions and comments on the EIA program, which have to be taken into account by the developer of the EIA documents.

The EIA procedure is scheduled to be completed by the end of 2008. It is planned that at least the first unit of the new nuclear power plant would be in operation not later than 2015. Typical construction time of a new NPP unit is 4–5 years and operation time is 60 years or even more.

VOCABULARY

Activity	The quantity A for an amount of radionuclide in a given energy state at a given time, defined as $A=dN/dt$,where dN is the expectation value of the number of spontaneous nuclear transformations from the given energy state in the time interval dt. The unit of activity is the s^{-1}, termed the Becquerel (Bq), 1 Bq = 1 s^{-1}.
bar	A unit of pressure. 1 bar = 100 000 pascal (Pa). Atmospheric pressure is approximately 1 bar.
Bq, Becquerel	The SI unit of activity, equal to one transformation per second.
BWR, boiling water reactor	A light-water reactor in which water used as the coolant boils as it passes through the reactor core. The resulting steam is used for driving a turbine.
CANDU reactor	CANDU (CANada Deuterium Uranium) is a pressurized heavy water reactor which uses natural uranium (0,72% U-235) as a fuel and heavy water for cooling and neutron moderation.
CANDU reactor, ACR type	The advanced CANDU reactor can be considered as a hybrid form of PWR, having a different reactor design. It is a light-water-cooled reactor that incorporates features of both Pressurised Heavy Water Reactors (HWR) and Advanced Pressurized Water Reactors (APWR) technologies.
C-14, carbon-14	In addition to radon, the Carbon-14 isotope is the most significant source of radiation exposure in a uranium fuel cycle.
Deuterium	Isotope of hydrogen which nucleus contains one proton and one neutron
Efficiency	The ratio of the amount of electric energy produced by a power plant to the amount of energy contained in the consumed fuel.
EIA	Environmental impact assessment.
Electrical power	The rate at which electrical energy is generated at power plant
Fission	The splitting of a heavy atomic nucleus into two parts, accompanied by the release of fast neutrons.
Heavy water	Heavy water is chemically the same as regular (light) water, but with the two hydrogen atoms (as in H_2O) replaced with deuterium atoms (hence the symbol D_2O). Deuterium is an isotope of hydrogen; it has one extra neutron.
IAEA	International Atomic Energy Agency, The IAEA is the world´s center of cooperation in the nuclear field. The Agency works with its Member States and multiple partners worldwide to promote safe, secure and peaceful nuclear technologies.
INES	International Nuclear Event Scale, is used for facilitating rapid communication to the media and the public regarding the safety significance of events at all nuclear installations associated with the civil nuclear industry, including events involving the use of radiation sources and the transport of radioactive materials.

Ionising radiation	Radiation capable of producing ion pairs with differing charges in the biological environment.
Isotope	Atoms of the same element differing from each other in the number of neutrons in their nucleus. Almost all natural elements occur as more than one isotope.
Light water	Regular water, H_2O
LWR, light water reactor	Reactor type in which regular water is used for cooling and as a moderator. Most nuclear power plant reactors in the world are light water reactors.
Maintenance	Complex of planned and systematically implemented activities aimed at ensuring reliable operation of systems (components) and maintaining their design characteristics within their design lives. Maintenance includes general service, overhaul, medium and current repair works, replacement of spares and design modifications of systems (components), as well as tests, inspections and calibration whenever necessary.
MW, megawatt	A unit of power (1 MW = 1 000 kW).
Nuclear Power Plant (NPP)	A complex of equipment and buildings intended for generating electricity or electricity and heat by using nuclear fuel.
Nuclear fission	Nuclear reaction of a heavy atomic nucleus and neutron which leads to subdivision of nucleus into two fragments and producing 2-3 fast neutrons.
Nuclear fuel	Nuclear materials used for nuclear power generation.
Nuclear materials	Any metal alloy, chemical compound or material mixture which contains plutonium, uranium (enriched in the isotope 235 or 233; or depleted) and thorium.
HWR, pressurized heavy water reactor	A heavy-water reactor in which heavy water is kept under pressure in order to raise its boiling point, allowing it to be heated to higher temperatures and thereby carry more heat out of the reactor core.
PWR, pressurized water reactor	A light-water reactor in which the water used as coolant and neutron moderator is kept under such a high pressure that prevents it from boiling regardless of the 300°C temperature. The water that has passed through the reactor core releases its heat to the secondary circuit water in separate steam generators. It boils into steam that is used for driving a turbine.
Project implementing company	Project implementing company is responsible for carrying out project implementation activities in compliance with the safety requirements imposed on nuclear activities. Having fulfilled the requirements laid down in legal acts and having received authorisations and licences, the project implementing company become the operator of the nuclear power plant and expand electricity generating capacities in accordance with the procedure laid down by legal acts. (ref. The Republic of Lithuania Law on the Nuclear Power Plant, State Journal, 2007, No. 76-3004)
Project organization	Organization, which is responsible for the proposed economic activity (Lietuvos Energija AB)

Radioactive materials	Material containing one or more radionuclides which activities must be considered from the point of radiation protection.
Radioactive noble gases (RNG)	The noble gases are helium (He), neon (Ne) argon (Ar), krypton (Kr), xenon (Xe) and radon (Rn). Some of these isotopes are radioactive. The permanent activity monitoring of radioactive noble gases (Ar-41, Kr-85, Kr-85m, Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135m, Xe-135, Xe-138) released to atmosphere at Ignalina NPP is performed.
Radioactive waste	Spent nuclear fuel and other materials for which no further use is foreseen and which contains, or is contaminated with, radionuclides at concentrations or activities greater than clearance levels.
Radioactivity	Transformation of an atomic nucleus into other nuclei. A radioactive nucleus emits radiation characteristic to the transformation (alpha, beta or gamma radiation).
Gaseous radioactive emissions	Radioactive material particles released from the source to atmosphere.
Waterborne releases	Radioactive effluents, released to environment.
Radioactive emissions	Radioactive pollutant in gaseous form, as aerosols, liquids or in other form released into environment.
Specific activity	Ratio of the sample's activity and its mass (unit – Bq/kg)
Spent nuclear fuel (SNF)	Nuclear fuel irradiated in the active zone of a reactor if the organisation operating the reactor officially registers following the procedures set by the state or state delegated authority and/or the supervising institutions that the fuel will no longer be used in reactors.
Sv, sievert	An ionising radiation dose unit indicating the biological effects of ionising radiation. As it is a very large unit, millisieverts (1 mSv = 0,001 Sv) and microsieverts (1 µSv = 0,001 mSv) are more commonly used.
Thermal power	The rate at which thermal energy is generated in the reactor
Tritium	Radioactive isotope of hydrogen (H-3). The nucleus of tritium contains one proton and two neutrons.
TWh, terawatt-hour	A unit of energy. One terawatt-hour equals one billion kilowatt hours or one thousand gigawatt hours.
UNECE, United Nations Economic Commission for Europe	Founded in 1947, UNECE, the United Nations Economic Commission for Europe, is one of the five regional commissions of the United Nations. Its aim is to strengthen the economic cooperation between its member countries.
Uranium	An element with the chemical symbol U. Uranium comprises 0,0004% of the earth's crust (four grammas in a ton). All uranium isotopes are radioactive. Natural uranium is mostly in the form of isotope U-238, which has a half-life of 4,5 billion years. Only 0,72% of natural uranium is in the form of isotope U-235, which can be used as a nuclear fuel.

1 GENERAL INFORMATION

Lietuvos Energija AB has initiated the environmental impact assessment procedure concerning a new nuclear power plant in Lithuania. The power plant would be located in the near vicinity of the current Ignalina nuclear power plant units. The net electrical output of new nuclear power plant would be at most 3 400 MW and it would replace the current Unit 1, which was closed on December 31, 2004 and Unit 2, which is scheduled to shut down at the end of 2009.

Presently the Ignalina Nuclear Power Plant (INPP) is the only nuclear power plant in Lithuania. About 70% of the total domestic electricity production was generated by the INPP in 2005. The current Lithuanian electricity generating capacities, including small capacity combined heat and power plants that are planned to be constructed, will be sufficient to meet the national demand until 2013. After the shutdown of INPP Unit 2 the new nuclear power plant would become the major electricity generating source in Lithuania.

The planned new nuclear power plant would meet the aims of the National Energy Strategy (*State Journal Nr. 11-430, 2007*). According to the strategy, one of the identified main tasks is "to ensure the continuity and development of safe nuclear energy; to put into operation a new regional nuclear power plant not later than by 2015 in order to satisfy the needs of the Baltic countries and the region".

According to the Law on the Assessment of the Impact on the Environment of the Planned Economic Activities (*State Journal 2005 No. 84-3105*) construction, shutdown or decommissioning of nuclear power plants or other nuclear facilities are such economic activities for which an environmental impact assessment procedure must be carried out.

The objectives of EIA are defined in the Article 4 of the Republic of Lithuania Law on the Assessment of the Impact on the Environment of the Planned Economic Activities (*State Journal 2005 No. 84-3105*) and shall be as follows:

- To identify, characterize and assess potential direct and indirect impacts of the proposed economic activity on human beings, fauna and flora; soil, surface and entrails of the earth; air, water, climate, landscape and biodiversity; material assets and the immovable cultural heritage, and interaction among these factors;
- To reduce or avoid negative impacts of the proposed economic activity on human beings and other components of the environment, referred to in paragraph above; and
- To determine if the proposed economic activity, by virtue of its nature and environmental impacts, may be allowed to be carried out in the chosen site.

The main objective of EIA program is to determine the content of the EIA report and the issues that shall be investigated in it. The content and structure of this EIA program meet the requirements of the Republic of Lithuania law on the assessment of the impact on the environment of the planned economic activities (*State Journal 2005 No. 84-3105*) and consider the requirements of the regulations on preparation of environmental impact assessment program and report (*State Journal 2006, No. 6-225*).

1.1 ORGANIZER OF THE PROPOSED ECONOMIC ACTIVITY

The organizer of proposed economical activity is Lietuvos Energija AB.

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Contact person	Mr. Tadas Matulionis
Telephone	+370 5 278 2589
Fax	+370 5 212 6736
E-mail	tadas.matulionis@lpc.lt

1.2 DEVELOPERS OF THE EIA PROGRAM

The developer of EIA Program is Consortium Pöyry Energy Oy (Finland) and Lithuanian Energy Institute (Lithuania). Pöyry Energy Oy is the leader of the Consortium.

Organization	**Pöyry Energy Oy**	**Lithuanian Energy Institute, Nuclear Engineering Laboratory**
Address	Tekniikantie 4 A, P.O. Box 93 FI-02151 Espoo Finland	Breslaujos 3, LT-44403 Kaunas Lithuania
Contact person	Mr. Mika Pohjonen	Mr. Povilas Poskas
Telephone	+358 10 33 24346	+370 37 401 891
Fax	+358 10 33 24275	+370 37 351 271
E-mail	firstname.lastname@poyry.com	poskas@mail.lei.lt

1.3 NAME AND CONCEPT OF THE PROPOSED ECONOMIC ACTIVITY

The proposed economic activity is named as the "New Nuclear Power Plant in Lithuania".

By this proposed economic activity a new nuclear power plant will be constructed in the vicinity of the existing Ignalina NPP. Total electricity production of the new NPP will not exceed 3 400 MW.

1.4 STAGES OF ACTIVITY AND SCHEDULE

The proposed economic activity can be divided into three main stages:

- Construction and commissioning;
- Operation;
- Decommissioning.

It is planned that at least the first unit of the new nuclear power plant is in operation not later than 2015. Typical construction time of a new NPP unit is 4 – 5 years, operation time is approximately 60 years or even more. Decommissioning time depends on the decommissioning strategy and can last from 20 to 100 years.

1.5 ELECTRICITY PRODUCTION

Assuming that electrical power of the new NPP will be about 3 400 MW and it will operate 7 000 hours per year, the annual electricity production will be about 24 TWh.

1.6 DEMAND FOR RESOURCES AND MATERIALS

Annual demand for resources and materials during construction and operation of the new NPP will be presented in the EIA report.

1.7 SITE STATUS AND TERRITORY PLANNING DOCUMENTS

The considered sites for the new NPP (see Figure 1-1) are within an industrial land area allocated for State Enterprise Ignalina NPP (land parcel No. 4535/0002:5) (*Utena region governor order No. 14-293, dated June 20, 2003, On permission of State land usage at Ignalina region*). In accordance with land usage specialty (*State land usage specialty Nr. PN 45/03-0071, Ignalina, July 2, 2003*) State Enterprise Ignalina NPP is allowed to use the site for unlimited time period.

The land usage purpose is defined as “of other special purpose (production and distribution of electric energy, operation of nuclear power units, nuclear fuel storage, supervision and maintenance of energy installations and other)”. Due to the proposed economic activity the land usage will not need to be changed. The special land usage conditions will be considered also.

On December 12, 2006 Director of Visaginas municipality administration by the order No. ĮV-652 “Concerning to approval of detailed plan” has approved the new revision of a detailed plan for the land parcel No. 4535/0002:5, which was prepared by UAB “Urbanistika” and coordinated by the State Enterprise Ignalina NPP. The main goal was to optimize land usage. The changes in the new revision of the detailed plan will not affect the status of the proposed sites for the new NPP.

The proposed sites for the new NPP are within the existing INPP industrial site. 3 km radius sanitary protection zone (SPZ) is defined for Ignalina NPP site. After public exposure assessment which will be performed in the EIA Report, the updated boundaries of the SPZ will be proposed. There is no permanently living population within the existing sanitary protection zone and the economic activity is limited as well. The proposed economical activity is distant from residential areas.

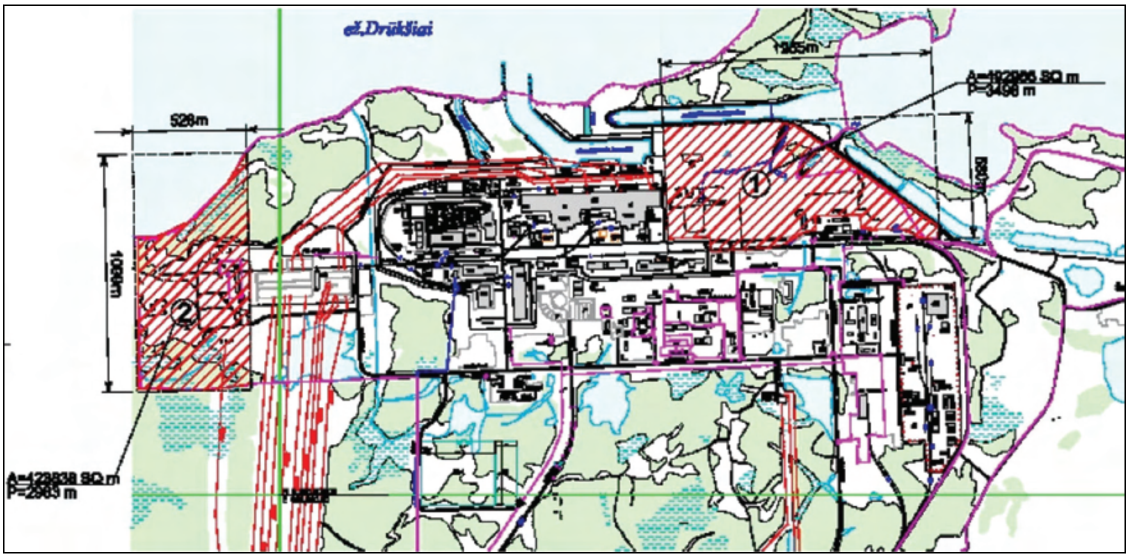


Figure 1-1. The proposed sites for the new NPP.

Alternative site 1 (see Figure 1-1, Figure 1-2) is situated east of Unit 2 of the present power plant and comprises the area, which was previously planned for Units 3 and 4. The site area is approximately 0.493 km^2 and ends at its northern side (length 0.6 km) directly at the cooling water discharge channel common for existing Ignalina NPP Units 1 and 2. In the south of Units 1 and 2, the area is limited by the road from west to east. The eastern part of this area is triangular shape due to the existing railways at its eastern border from north-west to south-east. At this eastern border there are digs filled with water, which are the partially constructed new cooling water channels for the previously planned Unit 4. The length of the western border is approximately 0.58 km. The perimeter of this site is approximately 3.5 km. At its southern border (length of 1.255 km) the interim spent nuclear fuel storage facility for Units 1 and 2 (buildings 192, 193 and 194) is located. Also buffer storage facility for very low level waste (LLW) and free release facility for existing INPP are planned to be built at southern border of alternative site 1. After erection of these buildings, the INPP security fence will be reconstructed in such a way, that all objects mentioned above will fall into the zone with physical protection border.

Figure 1-2. A view of alternative site 1 (east of current unit 2).

Alternative site 2 (see Figure 1-1 and Figure 1-3) is situated in an area west of the existing switchyard and it is currently unbuilt area (swamp, bushes). Its size is approximately 0.424 km^2. Its northern border is the shoreline of Lake Druksiai (length approximately 0.75 km). The other three borders are straight, forming a rectangular area, the eastern side of which is 1.1 km and the western 0.66 km long. The existing Building No. 106 (open switchyard) is in the area. Better road connection and new railway connection have to be built to the site.

Figure 1-3. A view of alternative site 2 (west of the existing switchyard).

Additional details, site description and land use planning documents will be provided in EIA report.

1.8 UTILIZATION OF THE EXISTING INFRASTRUCTURE

As a part of the environmental impact assessment, possibilities to use the existing Ignalina NPP infrastructure related to environmental monitoring, transportation, storage facilities for radioactive waste, electricity transmission lines, cold and water supply and so on will be evaluated and reported in the EIA report.

2 DESCRIPTION OF THE EIA PROCEDURE

2.1 GENERAL

Environmental Impact Assessment (EIA) is a process that predicts, examines and evaluates potential environmental impacts of a proposed economical activity and ensures that the decision makers know the public opinion before giving development consent and are provided with information about negative environmental effects, which might arise from development actions.

According to Lithuanian legislation, the EIA should be performed only for activities that have the potential for significantly affecting the environment due to the nature, size or proposed location of the activity. The activity of construction of nuclear power plants and other nuclear reactors is included in the List of the Types of Proposed Economic Activities that shall be Subject to the Environmental Impact Assessment (*Annex 1 of the Republic of Lithuania Law on Environment Impact Assessment*). Therefore performance of EIA for this proposed economic activity is obligatory. The planned schedule of EIA procedure for this proposed economical activity is presented in the following figure (Figure 2-1).

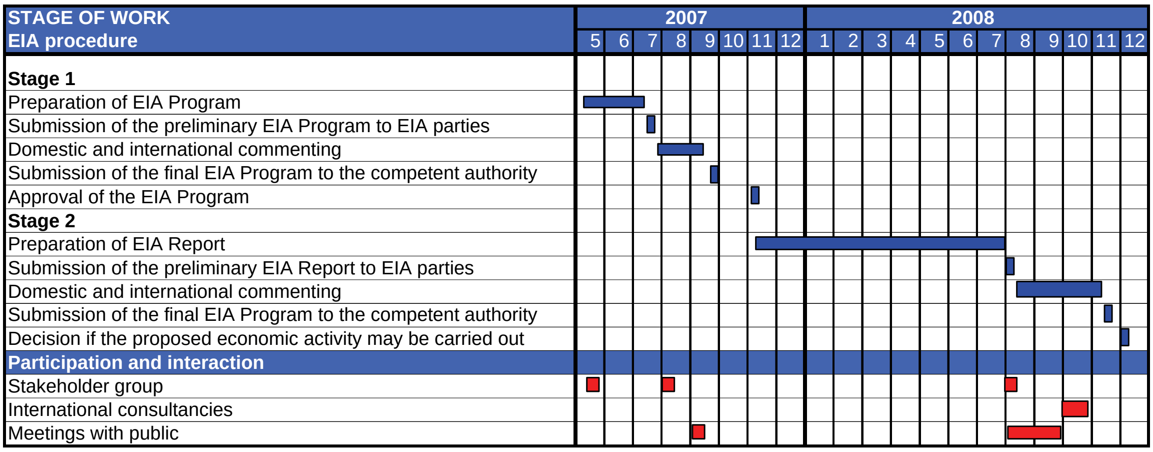


Figure 2-1. Planned schedule for the EIA procedure.

2.2 EIA PROGRAM AND EIA REPORT

The Republic of Lithuania Law on Environment Impact Assessment and law supporting regulations defines the legal requirements for the EIA procedure. The EIA is performed in two subsequent stages (Figure 2-2). In the first phase, the EIA program is prepared and presented to the authorities and public for a review. The EIA program defines the scope and content of EIA report and shall be approved by the competent authority (Ministry of Environment of Lithuania). In the second phase, the EIA report is prepared based on the approved EIA program and the opinions and statements. Before the competent authority makes a decision if the proposed economic activity is permitted on the chosen site, the EIA report is reviewed by the EIA parties and public.

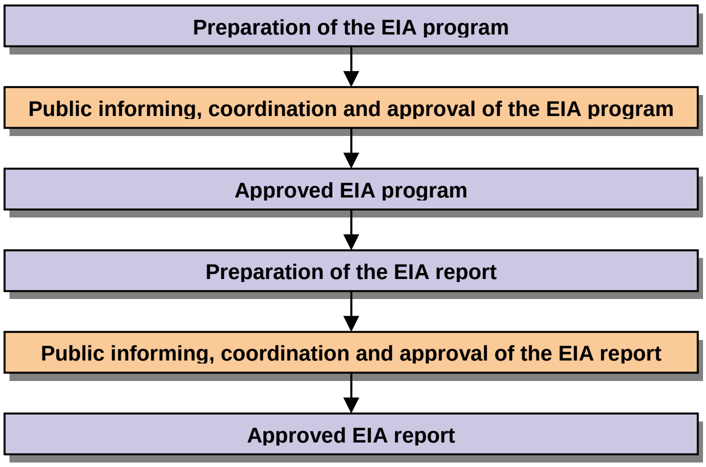


Figure 2-2. General overview of the EIA procedure.

2.3 PREPARATION OF THE EIA PROGRAM

It shall be noted that EIA is an interactive process, with feedback and interactions between involved parties at the various stages of the process. The procedure for coordination and approval of the EIA program is described in Figure 2-3. First, a prepared program is submitted to the relevant parties of environmental impact assessment. They examine the program and within 10 working days provide conclusions to the organiser (developer) of the proposed economic activity. The relevant EIA parties review EIA program and have a right to require for amendments or corrections of the program if the topics within the scope of their expertise are not proposed to be investigated sufficiently. Conclusions regarding the amended EIA program shall be then provided by the relevant parties of EIA within 5 working days.

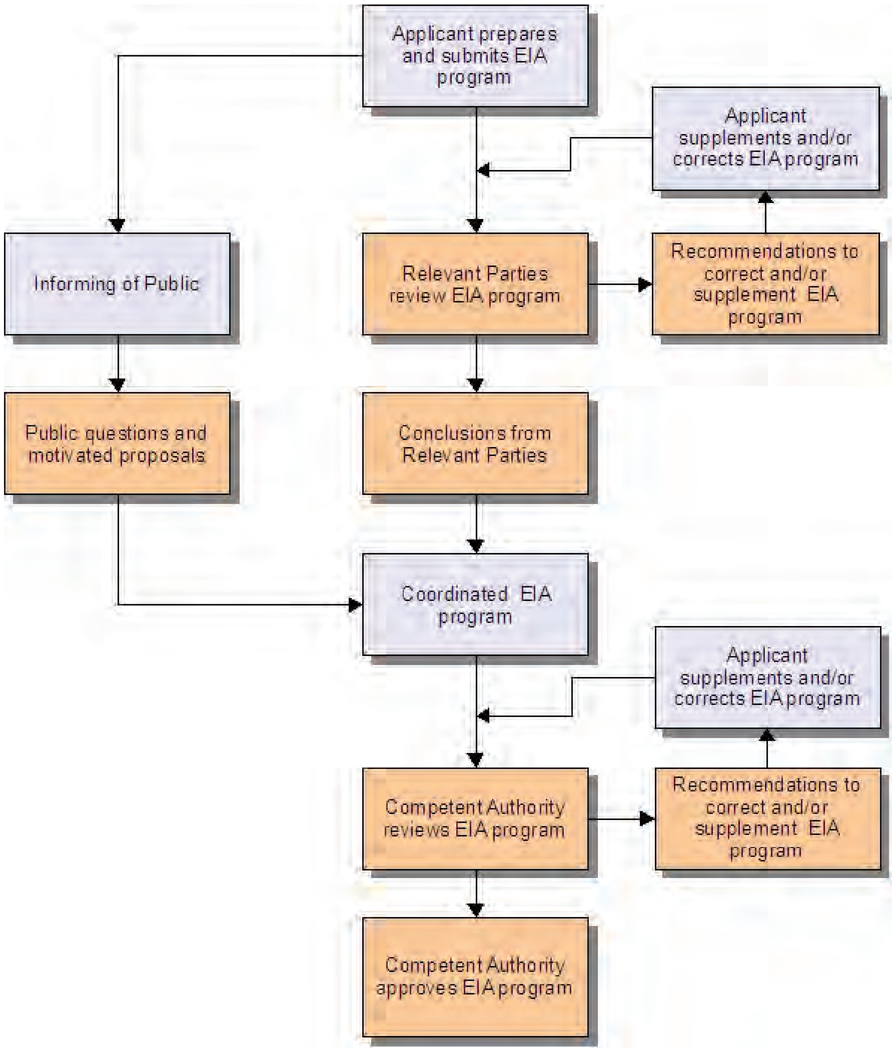


Figure 2-3. The procedure for coordination and approval of EIA program.

2.4 INFORMING THE PUBLIC

The organiser of the proposed economic activity (or the developer of EIA documents) shall inform the public about the EIA program in accordance with requirements of the Order of Informing the Public and the Public Participation in the Process of Environmental Impact Assessment (*State Journal, 2005, No. 93-3472*). The citizens have the right to examine the program and give their opinions on it. The developer of EIA according to the mentioned order of informing the public (*State Journal, 2005, No. 93-3472*) must perform registration of motivated (justified) proposals of the public regarding EIA, reasonably evaluate them and attach to the EIA program as appendixes.

2.5 REVIEW BY THE COMPETENT AUTHORITY

After receiving the conclusions from all relevant parties of EIA program and proposals from the public, the organiser (developer) submits them together with the program to the competent authority, which examines them and approves the program within 10 working days. The competent authority has the right to require for amendments or corrections to the program if the topics within the scope of its expertise are not proposed to be investigated sufficiently.

2.6 ENVIRONMENTAL IMPACT ASSESSMENT IN A TRANSBOUNDARY CONTEXT

According to the Lithuanian Law on Assessment of the Impact on the Environment of the Planned Economic Activities and to the United Nations Convention on Environmental Impact Assessment in a Transboundary Context (*Espoo Convention*), the competent authority has to inform the countries which might suffer the detrimental environmental impacts of the proposed economic activity. After the competent authority gets the responses from the countries concerned and their comments on the EIA program, it delivers them to the organizer of the proposed economic activity.

2.7 APPROVAL OF THE EIA-PROGRAM

In case of approval of the EIA program, the organiser (developer) can then start preparing the EIA report according to the approved program. The procedure for coordination and approval of the EIA report will be described in the EIA report.

3 PLAN OF COMMUNICATION AND PARTICIPATION

One of the objectives of the EIA procedure is to increase availability of information of the proposed economic activity and improve the opportunities for citizens' participation. In the following the intended means of communication and interaction in the EIA procedure of the new nuclear power plant are described. Parties involved in the EIA procedure are presented in the following figure (Figure 3-1).

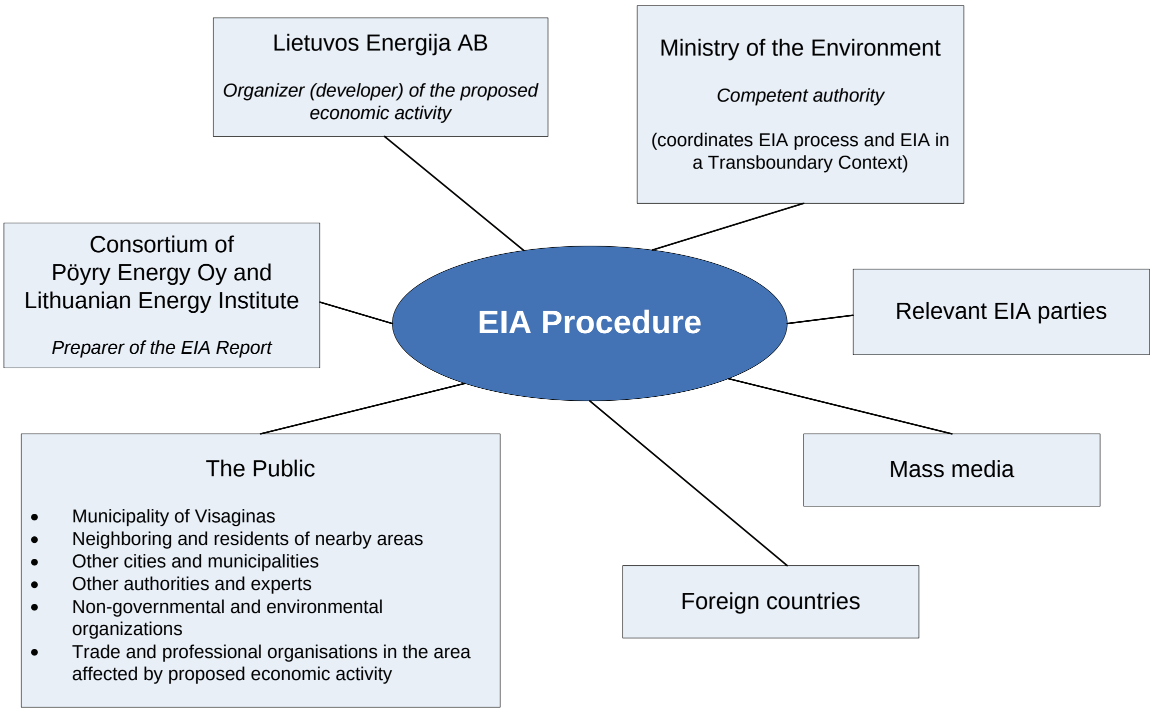


Figure 3-1. Parties involved in the EIA procedure.

3.1 STAKEHOLDER GROUP

The purpose of the Stakeholder Group is to promote the exchange of information between the organisation responsible for the project, the authorities and other interest groups. Based on the letter of the Ministry of Environment, the following parties were invited to the Stakeholder Group:

- Competent Authority
  - Ministry of Environment;
- EIA parties
  - State Nuclear Power Safety Inspectorate,
  - Radiation Protection Centre,
  - Fire and Rescue Department ,
  - Utena Public Health Service,
  - Utena Region Environmental Protection Department,
  - Cultural Heritage Protection Department,
  - Utena County Governor's administration,
  - Administration of Visaginas Municipality,
  - Administration of Ignalina district Municipality,
  - Administration of Zarasai district Municipality.

In the Stakeholder Group, EIA parties shall act as experts in their particular fields. Opinions expressed during discussions in the Stakeholder Group will not oblige the EIA parties giving later the official statements.

At its meetings the Stakeholder Group discusses the progress of the environmental impact assessment and presents opinions on the preparation of the EIA program, the EIA report and the supporting reviews. The Stakeholder Group convened first time on May 24, 2007 in which the project, the EIA procedure, interaction and the planned main content of the EIA program were presented to and discussed with the Stakeholder Group.

Comments and clarifications received during and after the meeting were taken into account in the preparation of the EIA program to the widest possible extent as far as they concerned the EIA program. Otherwise, any comments will be taken into account in the implementation of the EIA procedure and writing the EIA report.

The Stakeholder Group convened for the second time on August 14, 2007 after the EIA program has been submitted for EIA parties and public review.

3.2 INFORMATION AND DISCUSSION EVENTS

Information and discussion events open to the public will be arranged during the preparation of the environmental impact assessment program and report. At the events the general public will have the opportunity to discuss and express their opinions on the EIA work and its sufficiency and to receive information about the new nuclear power plant project and the EIA procedure from Lietuvos Energija AB and the authors of the EIA program. The first public event was arranged in autumn 2007 and the next event will be held during the EIA-report phase.

The EIA program for the new NPP has been presented to the public of Lithuania and neighboring countries in the following public meetings:

- September 3, 2007 in Daugavpils (Latvia);
- September 14, 2007 in Visaginas (Lithuania);
- September 27, 2007 in Tallinn (Estonia).

3.3 REVIEW OF EIA PROGRAM AND EIA REPORT BY RELEVANT PARTIES

Relevant parties assess EIA Program and Report and have a right to give their conclusions to the organiser (developer), who have to take them into account.

3.4 PUBLIC DISPLAY OF THE EIA PROGRAM AND EIA REPORT

In the both EIA program and EIA report phase the organiser (or developer of EIA documents) of the proposed economic activity shall inform the public about the EIA program in accordance with requirements of the Order of Informing the Public and the Public Participation in the Process of Environment Impact Assessment (*State Journal, 2005, No. 93-3472*State Journal). The public has right to examine the program and express opinions about the EIA program and EIA report. The developer of EIA must perform the registration of received motivated (justified) proposals, reasonably evaluate them and attach to the EIA program as appendixes.

3.5 COORDINATION OF EIA PROCESS BY COMPETENT AUTHORITY

The competent authority is responsible for coordination of the EIA process and fulfils its functions set out in the Law on the Assessment of the Impact on the Environment of the Planned Economic Activities (*State Journal 2005 No. 84-3105*).

Within 10 work days since the EIA program was delivered the competent authority has either to approve the program or to present justified requests for its revision or additional information. Within 25 work days since the EIA report was presented the competent authority can give justified request to revise and/or amend the report or makes a justified decision that this activity, taking into account the requirements of the relevant legislations and regulations, by virtue of its nature and environmental impacts can be carried out in the chosen site.

3.6 OTHER COMMUNICATIONS

Lietuvos Energija AB will provide information of the project through press releases or press briefings. Summary brochures will also be prepared for communication. The first summary will be prepared once the EIA program is completed. It will describe the project, the EIA program and the remaining stages of the EIA procedure. The second summary will be prepared once the EIA report is completed. It will describe the project and the most important results of the environmental impact assessment.

The EIA program and the EIA report will also be available for viewing in public libraries in the local area.

There is information about the EIA procedure is also provided at Lietuvos Energija AB's website - http://www.le.lt. The website provides up-to-date information on the progress of the EIA procedure. The EIA program, as well as the EIA report, will be available at the above mentioned website.

3.7 ENVIRONMENTAL IMPACT ASSESSMENT IN A TRANSBOUNDARY CONTEXT

Environmental impact assessment in a transboundary context is regulated by the Law on the Assessment of the Impact on the Environment of the Planned Economic Activities and by the United Nations Convention on Environmental Impact Assessment in a Transboundary Context (*Espoo Convention*).

The parties to the Convention are entitled to participate in an environmental impact assessment procedure carried out in Lithuania if the detrimental environmental impacts of the project could potentially affect the country in question. Correspondingly, Lithuania is entitled to participate in an environmental impact assessment procedure concerning a project located in the area of another country if the impacts of the project could potentially affect Lithuania.

The Ministry of Environment is responsible for the practical organization of the environmental assessment procedures in a transboundary context. The Ministry of Environment has informed the respective institutions of Latvia, Estonia, Poland, Belarus, Finland, Sweden and Russia about the commenced environmental assessment process of the new nuclear power plant in Lithuania and it was inquired about their intent to take part in the environmental assessment procedure. The information letter was supplemented by the EIA program in English or Russian and a comprehensive summary in country's official language was attached. The above mentioned countries have an opportunity to present their suggestions and comments on the EIA program, which have to be taken into account by the developer of the EIA documents.

4 ALTERNATIVES

The primary option for the project is a new nuclear power plant of 3 400 MW electrical power in Lithuania. The first unit of Ignalina NPP was shut down in 2004; the shut down of the second unit is scheduled for the end of 2009. Thus a new power plant as replacement is required. The maximal planned capacity (3400 MW) will be based on the reasonable environmental impact, taking into account possible technological, cooling alternatives and implementation of impact mitigation measures.

The alternatives can be divided into the following groups:

- location alternatives;
- cooling alternatives (direct and indirect (cooling towers) cooling; during preparation of the EIA study the modelling of the water body (lake Druksiai) as a cooler will be performed);
- technological alternatives (types of reactors);
- “zero” alternative.

4.1 LOCATION ALTERNATIVES

There are two options for the location of the new plant in the territory of the existing Ignalina nuclear power plant (Figure 4-1):

- Alternative 1: location east of the Ignalina NPP unit 2,

- Alternative 2: location west of the switchyard.

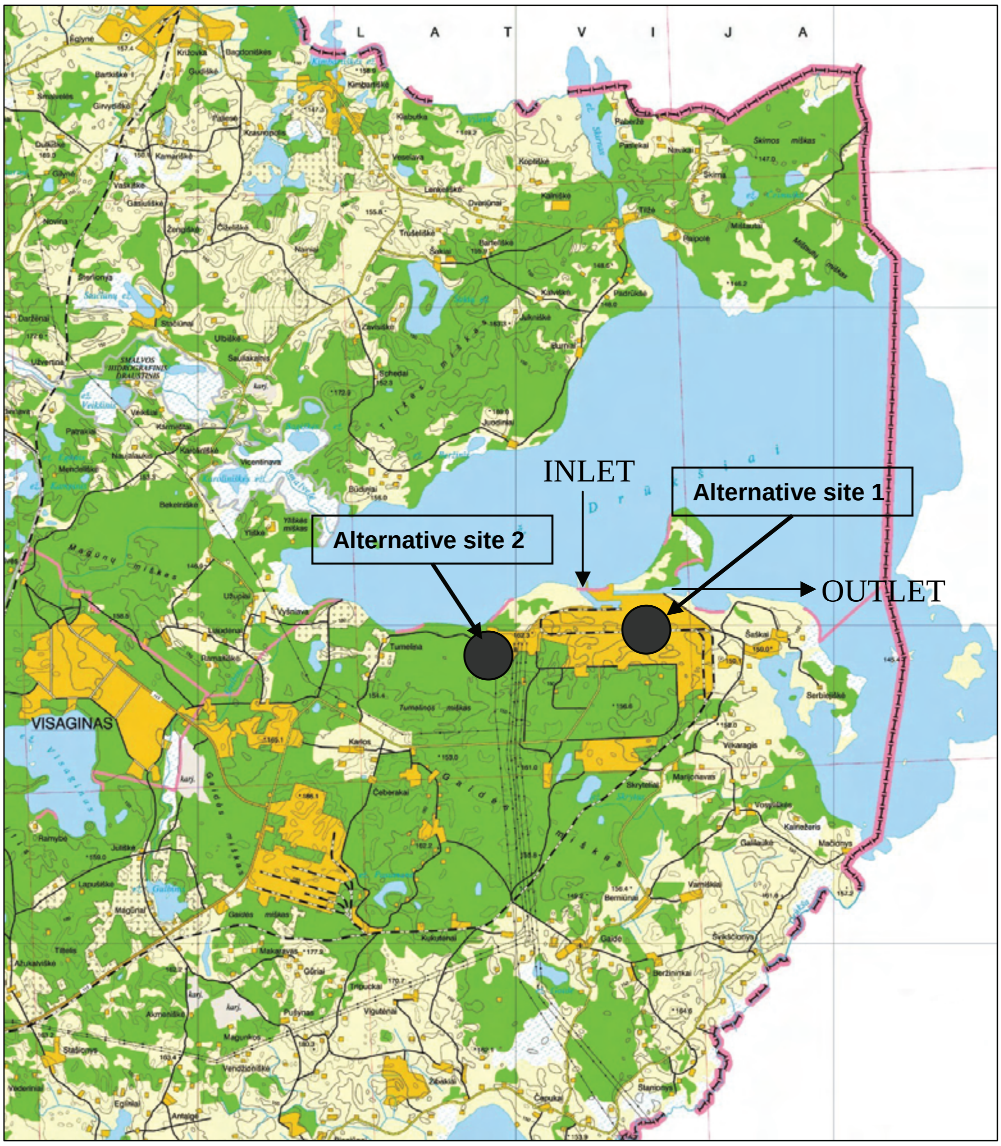


Figure 4-1. Location of alternative sites 1 and 2.

There is a 330 kV substation and switching yard installed within the current territory of the Ignalina nuclear power plant. The substation is connected to the high voltage electricity transmition network via six 330 kV electricity transmition lines. After the present Ignalina nuclear power plant Unit 2 will be closed, there will be no need to install the new electricity transmition network.

The construction of the nuclear facilities in the territory was started in 1974. From 1983 the nuclear reactors are operated, using the lake Druksiai water for their cooling. In 2009 the Ignalina nuclear power plant Unit 2 will be closed and the decommissioning works will until at least the 2030. Therefore it may be stated, that the purpose of the site remains the same – to produce electricity using nuclear energy, once the new nuclear power plant is constructed.

The current territory of the Ignalina nuclear power plant is the only territory in Lithuanian Republic, with the existing electricity transmition, cooling water, transportation roads, auxiliary facilities, which are necessary for the operation of the nuclear power plant, but also there are other nuclear facilities planned and/or under construction including the facilities for radioactive waste management and landfills.

After performing the geological surveys in 2006 and preparing the Feasibility Study of the new nuclear power plant and using the International Atomic Energy Agency's standards for evaluating the possible site options it has been concluded that sufficient space at the existing Ignalina nuclear power plant site is available to accommodate the nuclear power plant.

Comparison of the engineering geological conditions of the alternative construction sites will be presented in the EIA report.

4.2 COOLING ALTERNATIVES

The current locations for cooling water intake and discharge are also presented in the Figure 4-1. The alternative locations of the cooling water outlet and inlet channels for the new power plant will be assessed in the cooling water modelling study and obtained results will be summarized in EIA report.

The possibility to use indirect cooling (i.e. cooling towers) will be discussed in the EIA report.

4.3 TECHNOLOGICAL ALTERNATIVES (TYPES OF REACTORS)

The possible technical alternatives of the new plant are:

- pressurized water reactor (PWR)
- boiling water reactor (BWR)
- pressurized heavy water reactor (HWR)

The detailed description of the above mentioned reactor types is presented in Chapter 5.2.

4.4 NON-IMPLEMENTATION

So called 'zero-option' is that the new nuclear power plant unit will not be constructed in Lithuania. In this case the electricity consumption in Lithuania will exceed the electricity generation in Lithuania. Electricity generation and demand forecast in Lithuania will be presented in the EIA report. The supplies of energy from diverse, secure, sustainable energy sources which do not emit greenhouse gases and other pollutants will not be secured and the country's energy security will not be ensured. The zero-option assesses the environmental impacts of the production of the imported electricity on a general level. The electricity production of the zero-option corresponds to the electricity production of the planned new nuclear power plant (3 400 MW).

4.5 OPTIONS EXCLUDED FROM THE INVESTIGATION

Alternative locations of other places in Lithuania

There are not any other realistic options for the location of a new nuclear power plant in Lithuania, because it is essential for the project to utilise existing land use plans and infrastructure.

Energy saving

The organisation responsible for the project, Lietuvos Energija AB, does not have means to save energy in Lithuania so that the new nuclear power plant or corresponding amount of electricity would not be needed. Thus energy saving will not be investigated as an alternative to the new NPP.

Alternative ways to produce energy

Other options to generate the electricity would be by using other energy sources as oil products, coal, natural gas, peat, biofuels, hydropower or wind power. However, the nuclear power plant project organisation, and later project company, has been established for constructing and operating a new nuclear power plant in Lithuania and therefore does not have a mandate or possibilities to construct any other kind of power plants. If another company or organisation should begin to develop such power plants, the environmental impacts of them would be assessed as a part of those projects.

Thus impacts of alternative forms of electricity production in Lithuania will not be assessed in this EIA-process. However, the differences in impacts from other energy generating sources and nuclear power plants on air quality, the emissions of greenhouse gases and other pollutants caused by producing a corresponding amount of energy with other fuels (coal, gas, biomass) will be demonstrated.

5 TECHNOLOGICAL PROCESSES

5.1 OPERATIONAL PRINCIPLES OF A NUCLEAR POWER PLANT

Power plants that generate electricity from nuclear fuel are largely similar to plants that use fossil fuels (coal, oil, natural gas) as an energy source. The main difference between a nuclear power plant and a traditional steam power plant is the heat production method. The nuclear reactor in a NPP corresponds to the boiler in a steam power plant. A nuclear power plant uses enriched uranium dioxide (UO_2) as a fuel. The use of uranium as a fuel is based on the heat it yields when the atomic nucleus splits. The source of the heat is a kinetic energy of the fission products.

The fuel is compressed into small pellets and packed in gastight metal pipes, so called fuel rods. The fuel rods are bundled together as fuel assemblies. New, unused fuel is handled and transported safely according to requirements of Lithuanian legislation..

At power plants high-pressure steam is generated by heating water. This steam then “blows” the propeller blades of a turbine, which spins the shaft of an electricity generator. For a nuclear power plant, this high-pressure steam is generated by the energy released from the nuclear fission inside the nuclear reactor. When a fissile heavy nucleus (usually U-235) is struck by a neutron, it splits into two or more smaller nuclei as fission products, releasing energy and neutrons (this process is called nuclear fission). This nuclear fission is controlled and the energy released is used to heat water in order to produce steam at a high pressure. This steam is then led to a turbine that drives an electric generator.

Like all thermal power stations (like coal, oil, gas-fired ones), nuclear reactors also transform thermal energy into electrical power. Typically water is used for thus purpose. Water in one or two circuit systems is transformed into a steam, which rotates the turbine and turbine rotates electricity generator. Roughly a third of the generated heat energy can be converted to electrical energy. The excess heat is usually released into environment, in this case to Lake Druksiai. From the turbine, the steam is led to the condensers, where the cold water cools it and it turns back to water. The water used for cooling warms up and is discharged to Lake Druksiai. Water, which circulates inside the reactor, contains fission and activation products, but this water is not mixing with the cooling water at any process.

Nuclear power plant does not use oxygen, therefore it does not directly produce sulphur dioxide, nitrogen oxides, fine particles, mercury or other pollutants, that are produced in the combustion of fossil fuels and cause e.g. health impacts, ground-level ozone formation and acid rain. Nor does nuclear power plant produce carbon dioxide or other greenhouse gases causing global warming of the climate.

Spent nuclear fuel consists of highly active fission products of uranium and activation products. Spent nuclear fuel is managed and stored in an appropriate safe storage or disposal facilities according to current legislation of Lithuania.

The new power plant would be a base load power plant, meant to run continuously except for the annual maintenance period of few weeks. The estimated operation time of the plant is approximately 60 years. Table 5-1 presents preliminary technical data of the planned nuclear power plant.

Table 5-1. Technical information of the planned new nuclear power plant in Lithuania and of the existing Ignalina NPP. The numbers are preliminary and may change.

	New NPP	Ignalina NPP *
Description	**Value and unit**	**Value and unit**
Electrical power	3 400 MW	3 000 MW
Thermal power	8 700 MW	9 600 MW
Overall efficiency	35 – 40 %	~30%
Fuel	Uranium dioxide UO_2	Uranium dioxide UO_2
Amount of uranium in the reactors	90 – 500 tonnes	~370 tonnes
Annual electricity production	24 TWh_e	~20 TWh_e
Need for cooling water	80 – 120 m^3/s	150-160 m^3/s

* – technical data for Ignalina NPP is presented for two units. Operation period of Unit 1: 1983 – 2005; expected operation period of Unit 2: 1987-2009.

5.2 PLANT TYPE OPTIONS

Most of the nuclear reactors in the world are so-called light water reactors (LWR). LWR uses regular water to transfer the heat away from the reactor core. It also acts as a moderator. There are two types of LWR units: 1) the boiling water reactor (BWR) and 2) the pressurized water reactor (PWR). In addition, PHWR (pressurized heavy water reactors) reactor types are included in the options.

Boiling water reactor

In boiling water reactor the thermal energy, which is released from nuclear reaction, heats up the water so that it boils and energy is transferred with the steam from the reactor directly to the turbine (Figure 5-1).

The fuel is cooled by pure water. Within the pressure vessel, reactor coolant pumps circulate water through the fuel assemblies. This heats the water to a temperature of approximately 300 °C, which makes it boil and generate steam at a pressure of approximately 70 bar. The saturated steam is conducted through steam separators and a steam dryer located within the pressure vessel to a high-pressure turbine, an intermediate reheater and a low-pressure turbine. The turbines are linked by a shaft to a generator that produces electricity.

The steam coming from the low-pressure turbine is conducted to a condenser in which it is condensed into water using cold cooling water. There is underpressure in the condenser, meaning that in the case of a leak, cooling water will leak into the process, not vice versa. From the condenser, the water is pumped into pre-heaters. In the pre-heaters, steam extracted from the turbine heats the water before it is conducted back to the reactor.

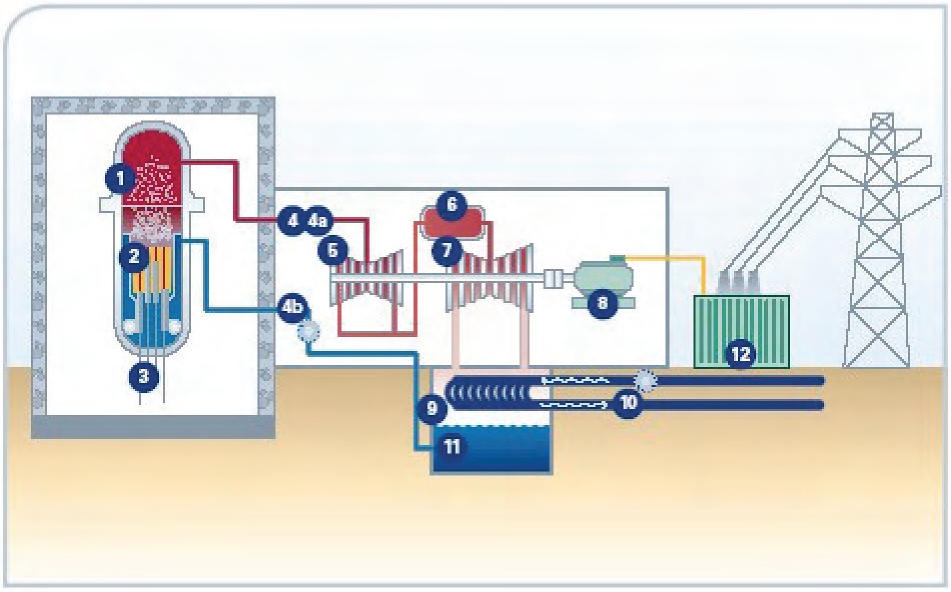


Figure 5-1. Operational principle of a boiling water reactor. 1. Reactor, 2. Core, 3. Control rods, 4. Primary circuit, 4a. Steam for the turbine, 4b. Water for the reactor, 5. High pressure turbine, 6. Reheater, 7. Low pressure turbine, 8. Generator, 9. Condenser, 10. Cooling water circuit, 11. Condensation water, 12. Transformer.

Pressurized water reactor

In pressurized water reactor the fuel heats up the water, but the water is pressurized to prevent it from boiling. The energy is transferred with the water to separate steam generators, from which the steam is conducted to the turbines (Figure 5-2).

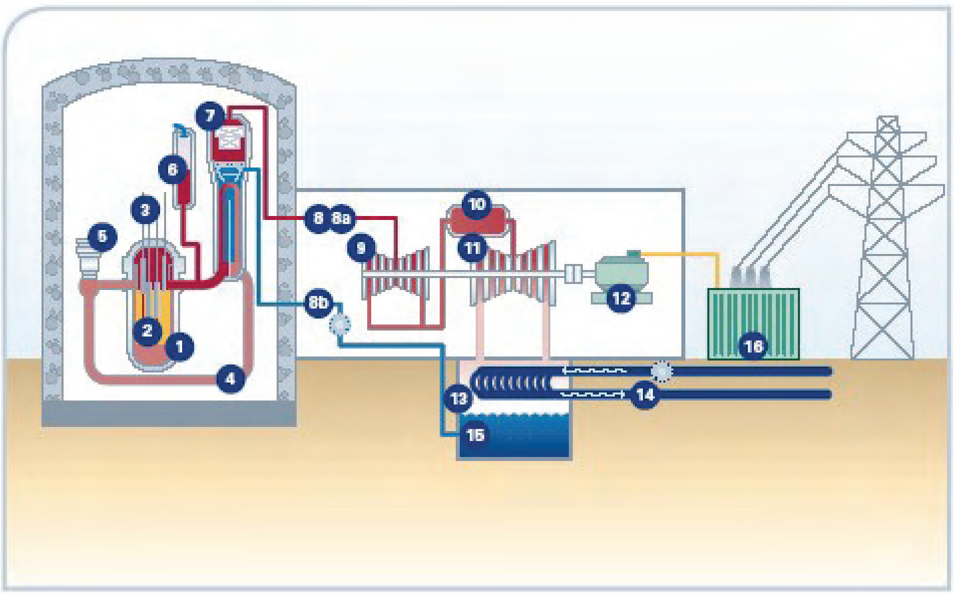


Figure 5-2. Operational principle of a pressurized water reactor. 1. Reactor, 2. Core, 3. Control rods, 4. Primary circuit (water circuit), 5. Main reactor coolant pump, 6. Pressurizer, 7. Steam generator, 8. Secondary circuit (steam), 8a. Steam for the turbine, 8b. Water for the steam generators, 9. High pressure turbine, 10. Reheater, 11. Low pressure turbine, 12. Generator, 13. Condenser, 14. Cooling circuit, 15. Condensation water, 16. Transformer.

The pressure is typically approximately 150 bar and the temperature in the reactor is approximately 300 °C. The pressurised water boils steam in separate steam generators from where it is pumped into the reactor (primary circuit). The steam circulates in the secondary circuit, operating the turbine and generator.

Pressurized heavy water reactors

In heavy-water reactor heavy water is kept under pressure in order to raise its boiling point, allowing it to be heated to higher temperatures and thereby carry more heat out of the reactor core. The advanced CANDU reactor (ACR) can be considered as a hybrid form. It incorporates features of both pressurised heavy water reactor (HWR) and pressurised water reactor (PWR) technologies. A large amount of heavy water is used for neutron moderation. Therefore, in comparison with other types of the reactors relatively large portion of neutrons is used for sustaining of chain reaction. Fuel used in reactor is natural uranium (0.72 % ^{235}U).

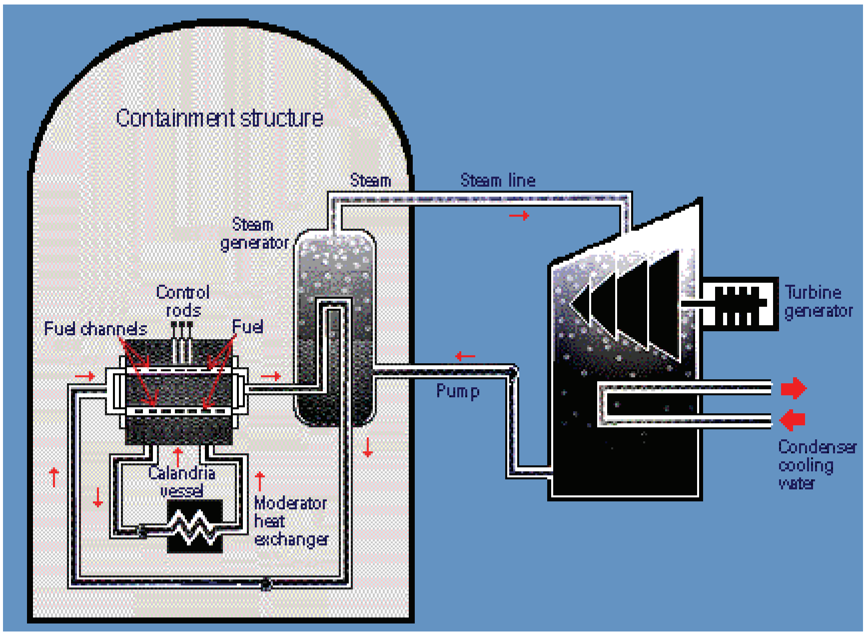


Figure 5-3. The operational principle of a pressurized heavy water reactor (CANDU, ACR type).

5.3 FUNDAMENTALS OF NUCLEAR SAFETY

A nuclear power plant must be designed in accordance with nuclear energy legislation and regulatory guides on nuclear safety in order to ensure the safety of its operation. Nuclear power plants have been developed and are continuously being developed in many ways to improve their safety and operational reliability. The latest safety requirements will be taken into account in the planned new power plant so that it can survive even for the most severe accidents without causing significant radiological consequences for the persons and environment.

According to VATESI normative documents (*VD-B-001-0-97 and VD-T-001-0-97*) and IAEA recommendations (*IAEA, 2005: Assessment of defence in depth for nuclear power plants*), fundamental safety functions are as follows:

- Management of reactivity,
- Fuel cooling,

- Localization, of radioactive waste, control of operational releases and limitation of accident releases.

The safety of a nuclear plant shall be guaranteed by applying the principle of "defense-in depth", i.e. by the sequential implementation of protection measures based on a system of barriers to prevent the spread of ionizing radiation and radioactive materials to the environment and a system of technical and organizational measures to protect these barriers and retain their effectiveness, and to provide direct protection for the population.

The system of barriers includes:

- the fuel matrix;
- the fuel element cladding;
- the boundary of the primary coolant circuit;
- a hermetically sealed protective enclosure surrounding localizing safety systems.

Lithuanian authorities supervise and control the safety of the power plant and require that the organization, operating the nuclear power installation, should ensure that the power plant is built, operated and decommissioned in accordance with the safety requirements.

5.4 PROCUREMENT OF FUEL

The manufacturing process of nuclear fuel consists of the following phases: quarrying and ore cleaning, conversion, isotopic enrichment, and packing into fuel assemblies.

Each of these production phases can be purchased from the market, mostly with long-term agreements. The major uranium producers of the world include Canada, Australia and Kazakhstan. Other significant producers include Russia, the USA, Brazil and some African countries. The most significant conversion plants are located in France, Canada, the USA and Russia.

The enrichment market is dominated by four suppliers: AREVA (France), Urenco (England, Germany, the Netherlands), Tenex (Russia) and USEC (the USA). Additional enrichment capacity can be found for example in Japan, China and Brazil. The manufacturing place of fuel assemblies is dependent on the plant type. The necessary production capacity can be found within the EU and in Russia.

5.5 RADIOACTIVE WASTE MANAGEMENT

The basis of radioactive waste management is the permanent isolation of waste from the environment.

Waste originating from nuclear power plants usually includes spent nuclear fuel, operating waste and the so-called decommissioning waste originating from the decommissioning of the plant.

Radioactive waste is classified and segregated in accordance with the physical state (solid, liquid or gaseous), chemical properties (aqueous waste or organic liquids) and radiological properties (very low, low or intermediate level waste, short-lived or long-lived waste). The segregation of the radioactive waste is carried out taking into consideration their flammable, pyrophoric, explosive and corrosive nature.

Radioactive waste pre-disposal management shall be performed in accordance to “Regulation on the Pre-Disposal Management of Radioactive Waste at the Nuclear Power Plant, VD-RA-01-2001”.

The basis of the waste management of the new plant is to utilise existing solutions at the INPP (designed or already in use) to the extent possible. The suitability of the existing radioactive waste management and storage facilities for the management and storage of the radioactive waste from the new NPP will be evaluated in the EIA Report. The capacity of these existing facilities will extended when it is necessary.

5.6 POWER PLANT RADIOACTIVE AND OTHER WASTES

During operation of the power plant high level, low level and intermediate level radioactive waste are generated.

High level waste comprises of spent nuclear fuel, constructive elements of SNF assemblies, and elements from the reactor core. After SNF is removed from the reactor core, it is usually stored inside storage pools. During this storage, the activity and heat production of the spent fuel decrease and then SNF is either moved to long-term storage facility, reprocessed or disposed. Information which will be presented in EIA Report is described in Chapter 6.2.2.

Most of the waste produced during normal operation is low in radioactivity. This waste mostly includes typical maintenance waste, such as isolation materials, paper, old working clothes, machine parts, plastics and oil. The intermediate-level waste mainly consists of the ion exchange resin from the purification system of the circulating water and the evaporator bottom from sewage water treatment.

The low-level and intermediate-level operating waste and decommissioning waste will be disposed of in the final repository constructed for them. Liquid waste will be solidified in the solidification facility. The operating and decommissioning waste of the new power plant will be solidified, dried and absorbed in a suitable medium. The possibility to extend the planned low and intermediate level short-lived radioactive waste repository (near surface disposal facility) and the planned very low level radioactive waste repository (Landfill facility) in order to dispose waste from the new plant will be evaluated in the EIA report.

The power plant also generates non-radioactive waste (utility type waste, non-hazardous and hazardous waste). Such kind of waste will be transferred to appropriate institutions in accordance with the requirements of the waste management legislation and regulations in force.

5.7 RADIOACTIVE EMISSIONS

The possible sources of gaseous radioactive releases include the following:

- leakage from the coolant, the moderator systems or the reactor itself;
- degasification systems for the coolant;
- condenser vacuum air ejectors or pumps;
- the exhaust from turbine seal systems;
- activated or contaminated ventilated air.

Emissions into the atmosphere can include noble gases, iodine, aerosols, tritium and carbon-14. Atmospheric emissions occur through the vent stack.

Radioactive effluents, i.e. technical water, household waste water (which had no contact with radioactive materials) and surface water (i.e. storm water) may be released into environment if the activity of the radionuclides does not exceed the limit activity, determined in the permission, issued by the Ministry of Environment.

Radioactive materials may be released into environment only after the permission for discharges of radioactive substances to the environment is obtained. This permission is issued by the Ministry of Environment to the operator of the nuclear installation according to the conditions and procedures established in regulations and following the requirements of the normative document LAND 42-2001 “On the Restrictions on the Release of Radionuclides from Nuclear Installations and Procedure for the Authorisation of Release of Radionuclides and Radiological Monitoring” (*State Journal, 2001, No. 13-415; 2005, No. 142-5136*).

Inventory and amount of radioactive releases will be evaluated in the EIA report.

5.8 OTHER EMISSIONS INTO AIR AND DISCHARGES INTO THE WATER

The diesel motors used for emergency power supply and possible heating boilers will be the main sources of non-radioactive pollutants released into the air from new NPP. During testing launch of the emergency electrical power supplying sources a certain amount of nitrogen oxide, sulphur oxide, solid particles and carbon dioxide is released. Standby heating boiler, which as fuel uses light oil, also generates a small amount of pollutants of the similar nature. Amount of pollutants released due to proposed economic activity, their dispersion and other parameters will be evaluated in the EIA report.

The operation wastewater, possibly polluted with petroleum products, will be generated in the turbine hall, at the diesel generator stations, in the vehicle service workshops and so on. Local treatment facility will be installed at these sites for oil separation, after which the water will be collected for additional treatment in the treatment facilities. The suitability of existing operation wastewater treatment facilities and the necessity of the new treatment facilities will be evaluated in EIA Report.

Surface drainage water collected from uncontrolled areas with no sources of hazardous materials for aquatic environment (i.e. grass-plots, roof of the buildings etc.) will be managed according to the Surface water management requirements (*State Journal, 2007, No. 42-1594*).

5.9 WATER SUPPLY

5.9.1 Raw water supply

Potable water to the new NPP will be supplied from the network of Visaginas municipality as is being done also at present. The water is taken from groundwater and used for everyday household purposes (drinking, showers, toilets).

Water from Lake Druksiai is used as service water, i.e. for purposes not requiring such a high quality, like washing floors etc.

The capacity of the potable and service water sources during the operational period (approx. 60 years) of the new NPP will be discussed in the EIA Report. Also the current state of existing facilities and infrastructure will be presented in the EIA Report.

5.9.2 Cooling water

The cooling water is necessary for NPP turbine condensers and other safety important systems and components. The cooling water for the new NPP will be taken from the Lake Druksiai. The cooling water need of the new NPP is estimated to be approximately 80 – 120 m^3/s.

The warmed cooling water will be led to Lake Druksiai. The alternative locations of the cooling water outlet and inlet channels for the new power plant will be assessed as part of the studies and presented in EIA report. Taking into consideration the environmental impacts of the heat load to Lake Druksiai, also the possibilities to use indirect cooling (i.e. cooling towers) will be assessed. In addition, the thermal impact of cooling water on aquatic ecosystem as well as bird population and other animals will be assessed. The assessment will be based on the information about the existing species and habitats. In addition, Natura assessment will be provided as lake Druksiai belongs to Natura 2000 – areas.

During the decommissioning phase of spent nuclear fuel removal from the reactor core and storage pools from the existing NPP, which is preliminary planned to be finished before the end of 2015, only one cooling water pump (*IAE letter No. 109-4859(12-14, dated 2007-08-27*) will be needed for the safety systems. The water amount needed (about 1.7 m^3/s) is very small amount compared to cooling water need of the new NPP. Thus there is no discrepancy in using the same inlet channel for new units.

6 WASTE

6.1 CONSTRUCTION OF THE NUCLEAR POWER PLANT

Estimated time of the construction of a new NPP is 4-5 years. There are different construction stages: earthwork, construction of unit(s), installation works, etc. No radioactive waste will be generated during the construction of a new NPP. The waste produced typically will be civil industry waste resulting from erection of reinforced concrete structures, installing of equipments and organizing of construction activities (i.e. construction debris, packaging material waste, personnel sanitary waste, waste water polluted with petroleum products and so on).

The waste produced during construction of the new NPP will be sorted and collected in holding tanks (for liquids) or containers (for solids) on site. Then the waste will be transferred outside of the site for appropriate processing and handling according to the requirements of the Low on Waste Management (*State Journal, 1998. No. 61-1726; 2002, No. 72-3016*) and Regulations for Waste Management (*State Journal, 2004, No. 68-2381*). No direct discharge of untreated effluents will be allowed. The contractor is obliged to manage all waste material and contaminated ground generated during construction from the construction site and storage areas and to provide any remediation work required to leave these areas in a neat and clean condition.

The appropriate measures to minimize waste generation will be implemented. The potential waste amounts arising during the construction of new NPP, waste treatment and potential impact to environment or absence of such impact will be described in the EIA report.

6.2 OPERATION OF THE NUCLEAR POWER PLANT

6.2.1 Non-radioactive waste

Solid non-radioactive waste generated during operation of the NPP will be for example utility type and non-hazardous waste (paper, plastic, etc.) and hazardous waste generated during the maintenance (burnt-out fluorescent lamps, batteries, used oil, etc.). In this case the waste will be managed according to the Lithuanian Low on Waste Management (*State Journal, 1998. No. 61-1726; 2002, No. 72-3016*) and the requirements of the Regulations for Waste Management (*State Journal, 2004, No. 68-2381*). The amounts of waste generated during the proposed economic activity, the ways of disposal and utilisation of waste will be properly described in the EIA report according to the requirements of the Regulations for Waste Management (*State Journal, 2004, No. 68-2381*).

6.2.2 Radioactive waste

Solid, gaseous and liquid radioactive wastes will be generated during the operation of the new NPP. The composition and the amounts of such waste will be evaluated in the EIA Report based on the operational experience of the existing LWR and HWR nuclear power reactors. Also according to existing practice the waste management, treatment and storage methods and their possible environmental impacts will be described in EIA Report.

Radioactive waste management program will be implemented at the new NPP. This program includes the following:

- keeping the generation of radioactive waste to the practicable minimum, in terms of both activity and volume, by using suitable technology;
- reusing and recycling materials to the extent possible;
- classifying and segregating waste appropriately, and maintaining an accurate inventory for each radioactive waste stream, with account taken on the available options for clearance and disposal;
- collecting, characterizing and storing radioactive waste so that it is acceptably safe;
- providing adequate storage capacity for anticipated radioactive waste;
- ensuring that radioactive waste can be retrieved in the end of the storage period;
- treating and conditioning radioactive waste in a way that is consistent with safe storage and disposal;
- handling and transporting radioactive waste safely;
- controlling effluent discharges to the environment;
- carrying out monitoring for compliance at source and in the environment;
- maintaining facilities and equipment for waste collection, processing and storage in order to ensure safe and reliable operation;
- monitoring the status of the containment for the radioactive waste in the storage location;
- monitoring changes in the characteristics of the radioactive waste, in particular if storage is continued for extended periods, by means of inspection and regular analysis;
- initiating, as necessary, research and development to improve existing methods for processing radioactive waste or to develop new methods, and to ensure that suitable methods are available for the retrieval of stored radioactive waste.

Solid radioactive waste

Solid radioactive waste may consist of spent ion exchange resins, cartridge filters and pre-coat filter cake, particulate filters from ventilation systems, charcoal beds, tools, contaminated metal scrap, core components, debris from fuel assemblies or contaminated rags, clothing, paper and plastic.

The solid radioactive waste composition and amounts will be described in the EIA report.

Liquid radioactive waste

The primary coolant in water cooled reactors and water from the spent nuclear fuel storage pools are major potential sources of liquid radioactive waste since some of their radioactive content may be transported to the liquid radioactive waste stream via process streams or leakages.

Sewage water from showers and toilets of supervised area, waste water from cleaning and decontamination of equipment and building structures of controlled area, condensation water from building structures and constructions surfaces in controlled area, condensation water from heating, ventilation and air conditioning system will be led to liquid radioactive waste treatment facilities. The suitability of existing treatment facilities and plants and the necessity of the new treatment facilities will be evaluated in EIA Report.

The liquid radioactive waste composition and amounts will be described in EIA report.

Spent nuclear fuel

The amount of spent nuclear fuel (SNF) will be estimated according to the operational experience of the existing LWR and HWR nuclear power reactors.

SNF is usually transferred to an interim spent fuel storage facilities after an initial period of storage at the reactor pools. This initial period of storage allows a considerable reduction in the quantity of volatile radionuclides, the radiation intensity and the production of residual heat.

In some new NPPs the capacity of reactor pools is designed for plant lifetime SNF accumulation. These can be considered as a form of interim storage.

Based on the existing operational experience of LWR and HWR nuclear power reactors the SNF amount and radiological characteristics will be described in EIA Report. Also based on existing experience different SNF management options (wet storage, dry storage, reprocessing, etc.) will be described in EIA Report. Long-term storage and disposal of SNF will be a subject of an own EIA procedure in the future.

6.3 DECOMMISSIONING

It is expected that the new NPP will operate about 60 years. After this time period the decommissioning process of a NPP will start. This process will generate the radioactive and non-radioactive waste of various physical states (solid, liquid, chemical and radiological properties. Since design lifetime of the existing INPP waste management facilities will be expired, the decommissioning waste of the new NPP will be processed in newly constructed appropriate waste management, treatment and storage facilities. Part of the resulting conditioned waste will be free released; disposed of into the landfill, near-surface repositories or temporarily stored on site.

During the design stage of the new NPP an initial decommissioning plan should be prepared before the operating licence is issued. The initial decommissioning plan should state in general terms that the plant can be taken out of service, and provide an outline of decommissioning methods and technologies. The initial decommissioning plan must specify the likely quantity of waste and provide an estimate of decommissioning costs.

Decommissioning plan shall be periodically updated. The updates are intended to reduce the impact of decommissioning on the public and the environment, and to ease the process by allowing for changes in decommissioning technologies and in radioactive waste management. Ongoing decommissioning plans should be corrected if systems and installations have been significantly altered, or if incidents or accidents have taken place resulting in unforeseen contamination of the INPP site and its systems.

If a decision is made to decommission the nuclear power plant or one of its units it is obligatory, five years in advance, to submit to VATESI a decommissioning program and final decommissioning plan after co-ordinating it with the Ministry of Economy, the Ministry of the Environment, the Ministry of Health, the Ministry of Social Security and

Labour, the county governor and the local authority of the territory which, in its entirety or in part, is within the facility sanitary protection zone. The Program should contain information about dismantling and conservation of equipments, management of radioactive materials and radioactive waste as well as later control and supervision of the object.

Proposed decommissioning procedures and methods will be described in EIA Report. Initial assessment of radioactive and non-radioactive waste amounts generated by decommissioning of the new NPP will also be presented.

7 PRESENT STATE OF THE ENVIRONMENT, ASSESSMENT OF POTENTIAL IMPACTS OF THE PROPOSED ECONOMIC ACTIVITY AND MITIGATION MEASURES

In the following chapter the present state of each component of the environment around the planned site for the new NPP is described. After that, the methodology of impact assessment to that component of environment is explained. In the end of each chapter typical mitigation measures for impacts on respective component of the environment is listed. These will be described in detail in the EIA report, based on the results of the impact assessment.

The impact assessment is based on the technical information, vast amount of literature available from the site environment as well as additional surveys. In environmental impact assessment the publication about Site Evaluation for Nuclear Installations Safety Requirements (IAEA 2003) and other appropriate recommendations will be taken into account.

The assessment of environmental impacts focuses on those impacts that are considered and felt to be significant. Information about issues felt important by citizens and various interest groups is obtained in connection with the notification and hearing procedures, among other things.

The significance of environmental impacts is assessed on the basis of, for example, the settlement and natural environment of the observed area as well as by comparing the tolerance of the environment with regard to each environmental burden. In addition to the investigations carried out, the existing specifications, such as release limits for radioactive materials will be employed in assessing the environmental tolerance.

The observed area, which refers to the area defined for each type of impact within which the environmental impact in question is examined and assessed, is aimed to be defined so large that significant environmental impacts cannot be expected to manifest themselves outside it.

The impacts during construction, operation and decommissioning time differ from each other and this is why the impacts are assessed divided into these three main categories.

7.1 THE STATE OF WATERS

7.1.1 Present state of the environment

7.1.1.1 Hydrogeological conditions

The new NPP area is located in the recharge area of the eastern part of the Baltic artesian basin. The hydrogeological cross-section data indicates presence of hydrodynamical zones of the active, slower and slow water exchange. Active water exchange zone is separated from the slower water exchange zone by 86–98 m thick regional Narva aquitard, located at the depth of 165–230 m. It is composed of loam, clay, domerite and clayey dolomite. The lower part of the aquitard contains an 8–10 m thick layer of gypsum-containing breccia. The slower water exchange zone is separated from slow water exchange zone by 170–200 m thick regional Silurian–Ordovican aquitard, located at the depth of 220–297 m (*Marcinkevicius et al. 1995*).

Thickness of the Quaternary aquifer system is 60–260 m (mostly – 85–105 m). This aquifer system includes seven aquifers: the upper shallow unconfined groundwater aquifer and six confined groundwater aquifers located in Baltijos–Grudos, Grudos–Medininku, Medininku–Zemaitijos, Zemaitijos–Dainavos, Dainavos–Dzukijos and Dzukijos intertill fluvioglacial deposits (*Marcinkevicius et al. 1995*).

The shallow aquifer is located in moor deposits (peat), aquaglacial deposits (sand, gravel, cobbles and pebbles), and the fissured upper part of the eroded silt of the glacial till, and the lenses of sand and gravel within the glacial till, here the aquifer is sometimes confined (*Marcinkevicius et al., 1995*).

The aquifers in the intertill deposits are composed of sand, gravel, and in some paleovalleys – cobble and pebble deposits. The thicknesses of different aquifers vary from 0.3–2 m to 20–40 m, and in paleovalleys – 100 m and higher (*Marcinkevicius et al. 1995*).

The confined aquifers in the intertill deposits are separated from each other by the low permeability till aquitards of sandy silt and silt, with lenses of sand and gravel. The thickness of different aquitards varies from 0.5 to 50–70 m, mostly – from 10–15 to 25–30 m (*Marcinkevicius et al. 1995*).

The Sventoji–Upninkai aquifer system is located under the Quaternary aquifer system in the interlayering deposits of fine and very fine grained sand, weak cemented sandstone, silt and clay. The aquifer system is 80–110 m thick. The water of the Sventoji–Upninkai aquifer system is used for the water supply for Visaginas town and INPP. The Visaginas town waterworks are located in about 4 km to the southwest from the new NPP sites. The Sventoji–Upninkai aquifer system is relative safe from the surface contamination. The system is covered by an isolating layer of more than 25 m and 50–75 % of its section is composed of clay or loam (*Vilniaus hidrologija Report, 2003*).

According to the field investigations performed in 1978 (*Report No 18939/DSP, 1978*) and later in 1981–1982 (*Report No 25090/DSP, 1981; Report No 26972/DSP, 1982*) the groundwater at the INPP site was found mainly to be at 1.0–4.0 m below the soil surface. Locally the groundwater was found at depths of 0–19 m below the soil surface. The typical feature is that the aquifer can consist of several hydraulically connected layers. The main flow is directed to the north and northeast towards Lake Druksiai.

7.1.1.2 Hydrological conditions

Lake Druksiai is the largest lake in Lithuania. The total volume of water is about 369×106 m^3 (water level altitude of 141,6 m). After evaluation of the operational status of the hydrotechnical constructions and operating regime of the new NPP (water demand and use), morphometric and hidrological characteristics of the damed lake will be revised in the EIA report. The total area of the lake, including nine islands, is nowadays about 49 km^2 (6,7 km^2 in Belarus, 42,3 km^2 in Lithuania). The greatest depth of the lake is 33 m and the average 7 m. The length of the lake is 14,3 km, the maximum width 5,3 km and the perimeter 60.5 km (*Hydro-physical Basis State in Lake Druksiai 1989; Basis State of Aquatic Animal Populations and Communities in Lake Druksiai 1986; Jakimaviciute et al. 1999*). Some characteristics of the lake are given in Table 7-1.

Table 7-1. Main data of hydrologic and hydrothermal regime of water cooling reservoir of the new NPP.

No	Characteristics of Lake Druksiai	Value
1.	The catchment area of Lake Druksiai, km^2	564
2.	Water area of lake at normal affluent level, km^2	49
3.	Multiyear flow rate of water from lake, m^3/s	3,19
4.	Multiyear discharge from lake, m^3/year	100,5 x 106
5.	Multiyear quantity of atmospheric precipitation, mm/year	638
6.	Multiyear value of evaporation from water surface, mm/year	600
7.	Normal affluent level of lake, m	141,6
8.	Minimum permissible lake level, m	140,7
9.	Maximal lake level, m	142,3
10.	Regulating volume of lake, m^3	43 x 106
11.	Permissible drop of lake level, m	0,90

The new NPP region is drained into watersheds of the rivers Nemunas (Sventoji) and Daugava. The small territory in the northeastern part of the region belongs to the upper course of the Stelmuze stream (Stelmuze–Luksta–Ilukste–Dviete–Daugava). The greater northern part of the region belongs to the Laukesa watershed (Nikajus–Laukesa–Lauce–Daugava). The greatest part of the region belongs to the Dysna watershed, which may be divided into two parts: the upper course of the Dysna and the Druksa watershed with Lake Druksiai (Druksiai lake – the present effluent Prorva – from the Drisveta or Druksa watershed – Dysna) (Table 7-2).

Table 7-2. The main river watersheds of the new NPP region.

River	Main watershed	The length of river till the new NPP region, km	The distance from the mouth, km	Watershed area, km^2	Average height of spring flood, mm
Sventoji	Nemunas	23,0	241,6	218	90
Dysna	Daugava	19,1	154,3	445,2	90
Druksa	Daugava	0,5	44,5	620,9	90
Laukesa	Daugava	2,3	29,1	274,9	95
Stelmuze	Daugava	3,8	7,8	48,3	100

There are a lot of lakes in the new NPP region. Their total area of water surface is 48,4 km^2 (without Lake Druksiai). The net density of rivers is 0,3 km/km^2. There are 11 tributaries to Lake Druksiai and 1 river that outflows it (the Prorva). The main rivers, which are connected to Lake Druksiai are the Ricianka (area of catchment: 156,6 km^2), the Smalva (area of catchment: 88.3 km^2) and the Gulbine (area of catchment: 156,6 km^2).

The catchment basin of Lake Druksiai (Figure 7-1) is small (only 564 km^2). The greatest length of the catchment basin (from south-west to north-east) is 40 km, maximum width is 30 km and average 15 km. The lake is characterized by relatively slow water exchange rate. The main outflow is the River Prorva (99% of all surface outflows) in the south part of the lake (*Jurgeleviciene et al., 1983*). Then, following the hydrographic net lake Druksiai → Prorva → Druksa → Dysna → Daugava → Gulf of Riga (at the Baltic Sea) which makes about 550 km, the outflows of the lake Druksiai enters the Baltic Sea.

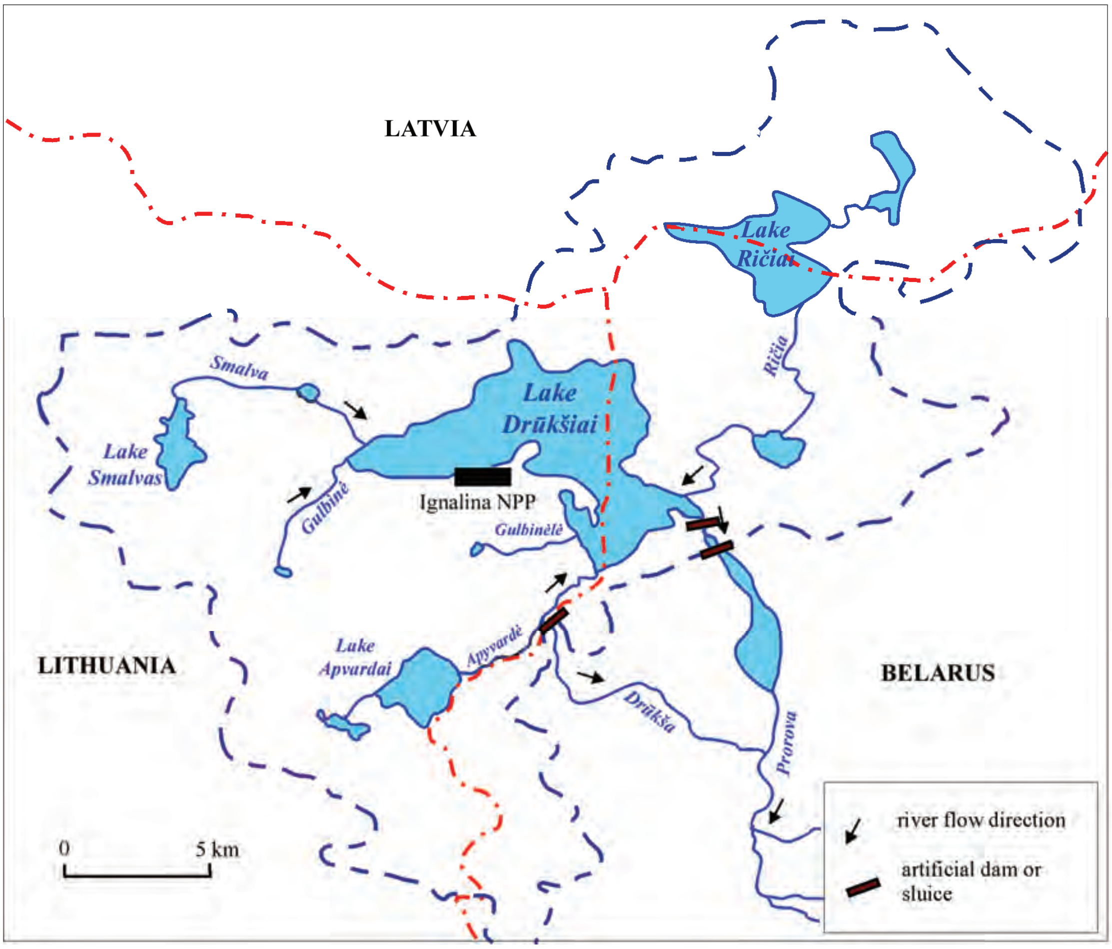


Figure 7-1. Scheme of Lake Druksiai catchment basin.

The region is dominated by clay, loamy and sandy loam soils, which are responsible for varying water filtration conditions in different parts of the region. The percentage of the forestland of the region is also varying widely, the highest being characteristic of Lake Druksiai basin. The average annual precipitation ranges from 590 to 700 mm. Two thirds of this value belongs to warm season. The snow cover accumulates 70 – 80 mm of precipitation. The summary evaporation from the land is about 500 mm (*Jurgeleviciene et al. 1983*).

7.1.1.3 Water regime of Lake Druksiai

Nearly all surface discharge (74%) flows to the south part of Lake Druksiai via rivers Ricianka and Drukse. The rest of the surface discharge goes to the west ridge from the tributaries of the rivers Smalve and Gulbine. Discharge from the lake goes via river Prorva through the south ridge of the water reservoir. Warm coolant water of the NPP is discharged into the same place. The most intensive water exchange takes place in the south part of the lake.

The water regime of Lake Druksiai is formed by correlation of natural and anthropogenic factors. The main natural factors are surface inflow (73%) and outflow (77%). Due to the large surface area precipitation (24%) and lake surface evaporation (23%) are also significant. The inflow of unconfined and semi-confined groundwater is insignificant (less than 3%). Outflow to the deeper laying water horizons is considered to be very low due to the permeability properties of bed sediments and deposits (*Hydro-physical Basis State in Lake Druksiai, 1989*).

The anthropogenic factors affecting the water regime are the control of the outflow by the hydro-engineering complex and cooling water circulation in the lake. A hydroelectric power plant “Tautu draugyste” was constructed on the Apvarda and Drukse rivers confluence in 1953. The discharge of Apvarda basin was directed through the river Druksa to the lake Druksiai. This has raised the water level in Lake Druksiai by 0.3 m. A new discharge line (corresponding this water level) to the river Prorva with a lock for regulation of the water level was formed. The hydro-engineering complex (power plant) was constructed on the River Prorva before the entrance to the lake Abaliai. It was planned to excavate a channel and to direct Visaginas effluents from the water treatment facilities to the rivers Apvarda and Drukse, passing the lake Druksiai by. However, this project was not implemented and effluents drain through the stream direct into the lake Druksiai until now. The yearly amount of water taken into the INPP (two units in 2002), used for cooling and discharged back to the lake is 9 times the volume of the lake and 27 times the natural influx of water to the lake (*UN/ECE, 2002*). However, it was shown that wind and bathymetrical distribution remain the major factors affecting the overall water dynamics of the Lake Druksiai while INPP has no significant impact (*Sarauskiene & Rimavičiute 2002*).

The sources of anthropogenic water releases are presented in Figure 7-2.

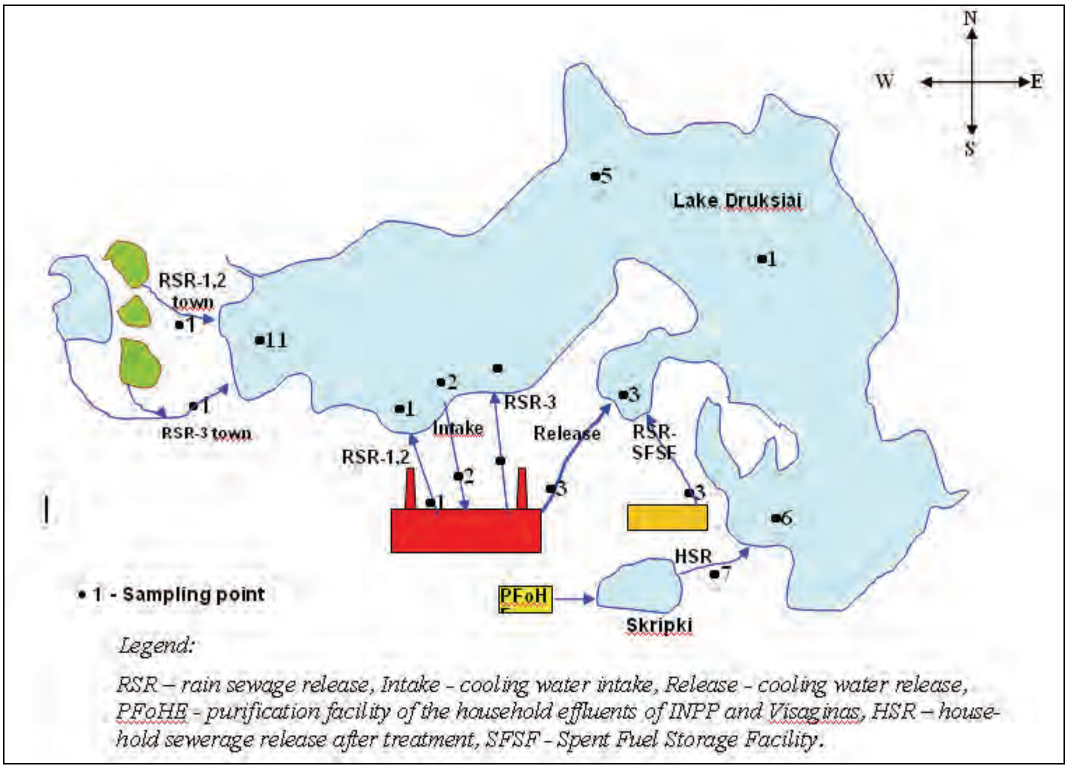


Figure 7-2. Inputs of cooling water and household wastewaters in Lake Druksiai.

The Ignalina NPP operation has no visible influence on the amount of atmospheric precipitation and on the water inflow into the lake. The NPP thermal releases have an influence on the evaporation from the water surface. The net losses of water from the lake depend on the amount of evaporation. The natural and additional evaporation from the water surface is monitored carefully (*Almenas 1998*).

7.1.1.4 Radioactivity in the Lake Druksiai

Permission to release radionuclides from the nuclear installations into environment is issued by the Ministry of Environment according to the requirements of the normative document LAND 42-2001 "On the Restrictions on the Release of Radionuclides from Nuclear Installations and Procedure for the Authorisation of Release of Radionuclides and Radiological Monitoring" (*State Journal, 2001, No. 13-415; 2005, No. 142-5136*). According to the existing rules, the Ministry of Environment issues permissions for Ignalina NPP for releases of radioactive material into environment. Waterborne radioactive materials released from Ignalina NPP to Lake Druksiai are continuously monitored. The information on radionuclides that have been actually released into the lake is presented in Table 7-3 (*INPP Report ПТОот-0545-14, 2007*). Existing releases to the water are far below the permissible values indicated in the valid permission of Ministry of Environment.

Lithuanian Hygiene Standard HN 87:2002 (*State Journal*, *2003*, *No. 15-624*) requires that the annual effective dose to the critical group members due to operation and decommissioning of nuclear facility shall not exceed dose constrain. – 0.2 mSv/year. Different release routes (e.g. into the environment air and 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 42-2001*).

Dose of the ionizing radiation to population due to the existing releases from Ignalina NPP into water is summarized in Table 7-4 (*INPP Report ПТОот-0545-14*, *2007*). The actual annual dose to critical group members of the population due to existing radioactive releases of the Ignalina NPP is about 1% of the established dose limit for release route into the water (0,1 mSv/year).

Potential radioactive releases from the new NPP and the other existing and planned nuclear facilities located in the same area will be evaluated and presented in the EIA report.

Table 7-3. Activity (10^6 Bq) of radionuclides released into Lake Druksiai during 2000-2006 and annual limit values.

Nuclide	Year							Annual limit value
	2000	2001	2002	2003	2004	2005	2006	
Cs-137	45,5	512	1190	386	245	21,4	24,6	20800
Cs-134	0	1,2	0	0,2	0	0	0	255,7
Mn-54	0,3	67,6	0,4	2,4	0,6	0,09	0	4374
Co-58	0	15,4	0	0,4	0	0	0	634,8
Co-60	39,9	424	8,1	0,9	17,9	10,7	0	37040
Fe-59	0	92,1	0	1,9	0	0	0	872,9
Cr-51	0	79,9	0	0,9	0	0	0	1323
Zr-95	0	83,8	0	0,4	0,2	0	0	670
Nb-95	0	129	0	0,7	0,3	0	47,9	975,7
I-131	0	0	0	0	0	0	0	8641
Sr-90	350	91	-	0	0	411	0	793,5
H-3	8,70E5	5,70E5	9,70E5	6,80E5	7,5E5	3,24E6	5,76E5	8,733E6
Total (gamma)	85,7	1400	1190	394	264	32,1	72,8	

Table 7-4. Annual dose (Sv) to critical group members of the population (during 2000-2006) due to radionuclides released to Lake Druksiai.

Nuclide	Year						
	2000	2001	2002	2003	2004	2005	2006
Cs-137	$1,09 \cdot 10^{-7}$	$1,23 \cdot 10^{-6}$	$2,85 \cdot 10^{-6}$	$9,26 \cdot 10^{-7}$	$5,88 \cdot 10^{-7}$	$5,1 \cdot 10^{-8}$	$5,98 \cdot 10^{-8}$
Cs-134	-	$9,09 \cdot 10^{-9}$	-	$1,71 \cdot 10^{-9}$	-	-	-
Mn-54	$3,0 \cdot 10^{-11}$	$5,54 \cdot 10^{-9}$	$3,0 \cdot 10^{-11}$	$1,9 \cdot 10^{-10}$	$4,8 \cdot 10^{-11}$	$7,4 \cdot 10^{-12}$	-
Co-58	-	$4,0 \cdot 10^{-10}$	-	$1,0 \cdot 10^{-11}$	-	-	-
Co-60	$4,79 \cdot 10^{-8}$	$5,09 \cdot 10^{-7}$	$9,72 \cdot 10^{-9}$	$1,13 \cdot 10^{-9}$	$2,14 \cdot 10^{-8}$	$1,28 \cdot 10^{-8}$	-
Fe-59	-	$1,57 \cdot 10^{-9}$	-	$3,0 \cdot 10^{-11}$	-	-	-
Cr-51	-	$1,0 \cdot 10^{-10}$	-	-	-	-	-
Zr-95	-	$4,4 \cdot 10^{-10}$	-	-	$1,11 \cdot 10^{-12}$	-	-
Nb-95	-	$1,80 \cdot 10^{-7}$	-	$9,7 \cdot 10^{-10}$	$4,41 \cdot 10^{-10}$	-	$6,71 \cdot 10^{-8}$
I-131	-	-	-	-	-	-	-
Sr-90	$6,57 \cdot 10^{-7}$	$1,73 \cdot 10^{-6}$	$9,42 \cdot 10^{-7}$	-	$6,93 \cdot 10^{-7}$	$7,81 \cdot 10^{-7}$	0
H-3	$7,46 \cdot 10^{-8}$	$1,76 \cdot 10^{-7}$	$2,33 \cdot 10^{-7}$	$1,07 \cdot 10^{-7}$	$1,20 \cdot 10^{-7}$	$1,13 \cdot 10^{-7}$	$2,02 \cdot 10^{-8}$
Total	$8,93 \cdot 10^{-7}$	$3,79 \cdot 10^{-6}$	$4,08 \cdot 10^{-6}$	$1,04 \cdot 10^{-6}$	$1,42 \cdot 10^{-6}$	$9,59 \cdot 10^{-7}$	$1,47 \cdot 10^{-7}$
Total (from γ nuclides)	$1,57 \cdot 10^{-7}$	$1,93 \cdot 10^{-6}$	$2,86 \cdot 10^{-6}$	$9,30 \cdot 10^{-7}$	$6,10 \cdot 10^{-7}$	$6,41 \cdot 10^{-8}$	$1,27 \cdot 10^{-7}$

7.1.1.5 Water temperature monitoring of Lake Druksiai

Regulation in force “Standard Limits of Permissible Warming of Lake Druksiai Water and Methodology for Temperature Control” (*LAND 7-95/M-02*) has been prepared for protection of the Lake Druksiai ecosystem, i.e. trophic regimen, water quality and fauna. According to this regulation the following standard limits are established for the Lake Druksiai:

- Water surface temperature shall not exceed 28 °C in the water area not less than the 80 % of total area of the lake (*Clause 1.1 of LAND 7-95/M-02*);
- In the cooling water inlet channel in a depth of 10 centimetres temperature shall be less than 24.5 °C (*Clause 1.2 of LAND 7-95/M-02*);
- Operation of two INPP units shall not be limited in the cool period of year (from October 1 till April 30) (*Clause 2 of LAND 7-95/M-02*).

In the methodological part of this regulation there are the following requirements:

- Temperature of the Lake Druksiai water is controlled by measuring a temperature of water surface in the flow of the INPP cooling water inlet channel always in the same point;
- Water surface temperature shall be measured in a depth of 10 centimetres each day from 10 till 12 o’clock;
- Temperature is measured by mercurial thermometer, standard error of which is ±0.2 °C. If measuring is performed using another devices, standard error of them shall not exceed ±0.2 °C;
- The measured lake water temperature shall be recorded in special register.

According to the existing practice and Ignalina NPP Environmental Monitoring Program the INPP is measuring temperature of:

- Inlet channel – every day, one measurement a day from 10:00 till 12:00 (designation: Intake near the Building 120/1, according to attachment 1 of the Environmental Monitoring Program), see Figure 7-2;

- All channels (namely RSR-1,2, Intake, RSR-3, Release, RSR SFSF, see legend in Figure 7-2, according to attachment 1 of the Environmental Monitoring Program) every fortnight;
- Lake Druksiai – 3 times per year (e.g. see Table 7-5, measurement locations are shown in Figure 7-3);
- Lake Druksiai, a lot of measurements over the area (Figure 7-4) – at the day when inlet channel water is more than 24.5 °C, usually 1–3 times per year, according to LAND 7-95/M-02.

If the standard limits of temperature of wastewater and water in inlet channel are exceeded i.e. temperature exceeds 28 °C in 80% of the lake surface, there must be a reduction of power production and discharge of cooling waters. The Lithuanian authority may make an exception from the Directive 78/659/EEC in particular conditions, if it is proven that this will not affect on the development of fish population.

Table 7-5. Water temperatures of the lake Druksiai.

Measurement date	Water temperature (°C) at the measuring positions 1, 2, 3, 4 and 6 shown on Figure 7-3				
	1	2	3	4	6
May 30, 2005	18,1	19,2	15,8	25,4	19,1
August 1, 2005	23,1	25,4	21,9	30,3	22,6
September 19, 2005	16,8	17,3	16,0	16,1	16,0
May 10, 2006	12,3	14,5	15,2	22,9	15,9
July 10, 2006	27,6	26,8	27,8	33,2	26,3
September 25, 2006	17,9	20,0	17,1	21,0	16,6

During the operation of one Ignalina NPP unit the heat load to the lake Druksiai is more than 0.06 kW/m^3 (i. e. the amount of heat transmitted to the lake per month is $8.7 \cdot 10^{15}$ J), and during the operation of two INPP units – 0.11 kW/m^3. Cooling water impact on lake temperature can be seen from Table 7-5 and Figure 7-4. Water temperature at the location 4 of the Lake Druksiai, where the cooling water is discharged, is approximately by 4–7 °C higher than at the location 2, where the cooling water is taken from.

In conclusion, although critical events occur in the year, the water temperature of the Lake Druksiai is usually below the limit values set by the Directive 78/659/EEC on cyprinid waters quality:

- Operation of the two INPP Units at full load has increased the average monthly temperature of the lake by 3 - 5 degrees;
- The lake temperature generally stays under the 28 °C, although it sometimes rises above that value under particular summer conditions (maximum exceeding allowed: 2% of time).

The proposed new NPP will be designed taking into consideration the existing experience of INPP for control of water surface temperature, regulations on permissible warming of Lake Druksiai and protection of existing state of the Lake Druksiai ecosystem against the possible changes due to operation of new NPP units.

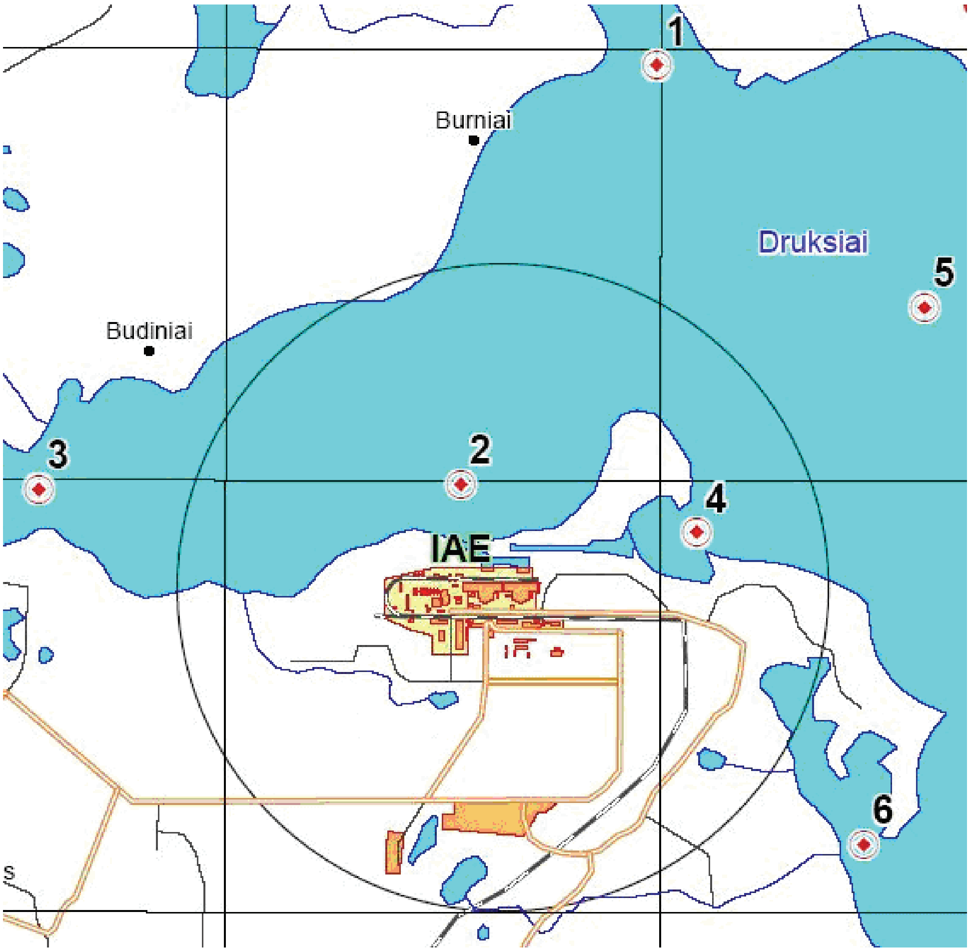


Figure 7-3. Locations for investigation of the “zero” background in the Lake Druksiai (location 5 is not used in last years because of close proximity to the state border with Republic of Belarus).

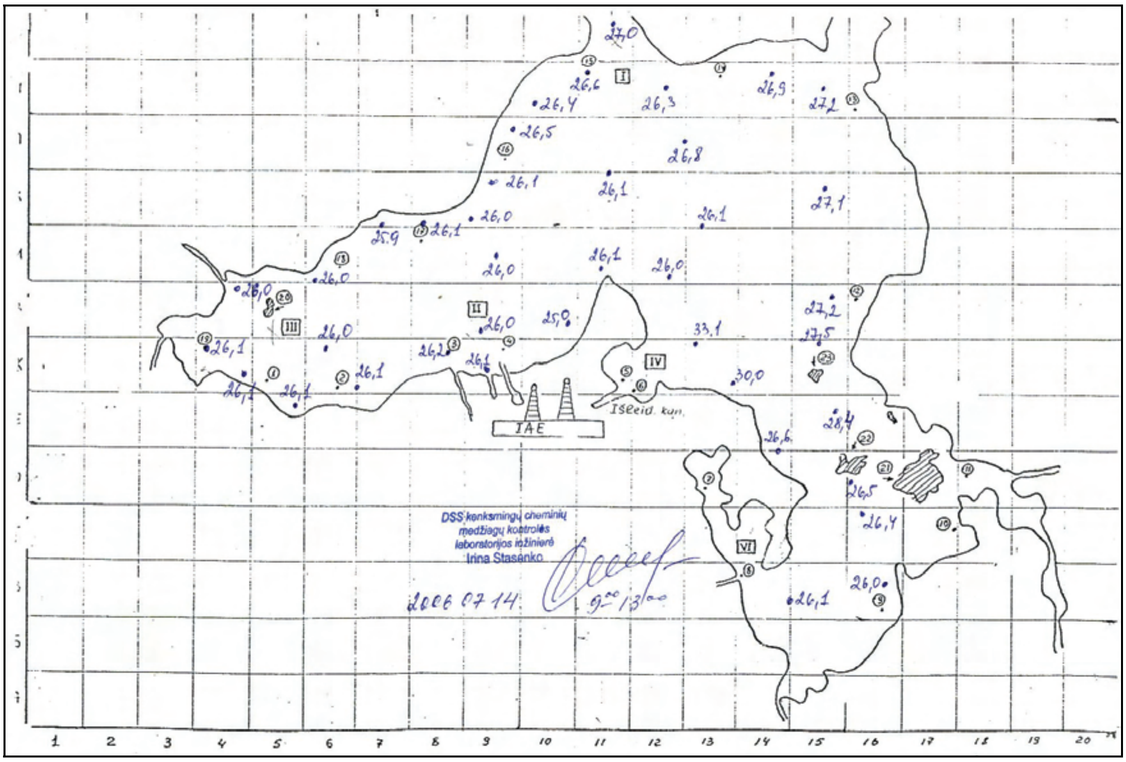


Figure 7-4. Water temperatures of the Lake Druksiai in July 14, 2006.

7.1.1.6 Water quality and biodiversity

Before the development of significant activities in the area, Lake Druksiai was mesotrophic. The addition of thermal and municipal wastewater releases made the lake water quality evolve to an almost eutrophic state and different ecological zones were formed in the lake.

In the special scientific program (*Final Report of State Scientific Research Program, 1998*) the impacts of INPP on the local ecology have been assessed. The research data (1989–1997) of INPP waste waters, the water quality of Lake Druksiai and its bottom sediments have shown that the functional and structural changes in Lake Druksiai biota are mostly caused rather by thermal and chemical than radioactive pollution. The municipal and industrial waste water are the most important sources of pollution.

Based on Ignalina AE monitoring program, samples of some fish species are continuously investigated by Ignalina NPP. The existing information of measurements is presented in Table 7-6 and Table 7-7 (*INPP Report ПТОот-0545-14, 2007*).

Table 7-6. Specific activity of radionuclides in the fishes catched in Lake Druksiai in 2006.

Fish	Specific activity, Bq/kg			
	Cs-137	Cs-137	Cs-137	Cs-137
Pike	1,25	0,21	107	1,46
Perch	2,18	0,86	127	3,04
Roach	0,84	0,44	100	1,28
Tench	0,46	0,42	95	0,88
Crucian	0,59	0,46	106	1,05
Bream	0,60	0,98	120	1,58
Average value	0,99	0,56	109	1,55

* – K-40 is naturally occurring radionuclide

Table 7-7. Average annual specific activity of radionuclides in fishes of Lake Druksiai.

Year	Specific activity, Bq/kg						Annual dose due to consumed fish (except. K-40), μSv
	Cs-137	Cs-134	Co-60	Sr-90	K-40*	Total (except K-40)	
1999	1,82	0	0	<20,0	86,6	1,82	0,22
2000	1,60	0	0	<20,0	63,5	1,60	0,21
2001	1,78	0	0	<20,0	93,5	1,78	0,23
2002	1,82	0	0	<38,0	127	1,82	0,23
2003	1,69	0	0	1,11	108	2,80	1,67
2004	1,10	0	0	1,52	101	2,60	1,70
2005	1,15	0	0	0,84	115	1,99	1,16
2006	0,99	0	0	0,56	109	1,55	0,86

* – K-40 is naturally occurring radionuclide

It is stated in Lithuanian Hygiene Standard HN 87:2002 (*State Journal, 2003, No. 15-624*) that annual effective dose for a member of population due to operation and decommissioning of nuclear facilities should be less than the dose constraint – 0.2 mSv per year. As can be seen from the Table 7-7, annual effective dose due to fish consumption makes about 0,5 % from the dose constrain i.e. is very low.

7.1.2 Assessment of impacts on water

Water consumption balance (m^3/d; m^3/y) will be presented in the EIA report. Description of water consumption and wastewater generation sources, amounts, quality and management will be presented in the EIA report.

The possible radioactive impact on waters due to radioactive releases from the new NPP will be assessed and presented in the EIA report.

Dispersion and flows of the cooling water depending on the discharge location and the influence of the new NPP thermal load on hydrology, hydrological balance and ice conditions of the lake Druksiai, chemical pollution of the lake (the main parameters indicating water quality and concentration of pollutants) as well as possible changes in water quality and biodiversity due to changes in hydrothermal regime will be evaluated as part of this analysis and presented in the EIA report. Evaluation will be based on the current status of the lake Druksiai and on the results of evaluated impact on environment caused by other sources of contamination (e.g. Visaginas sewerage). The assessment will be based on model calculations done earlier for INPP cooling waters and for comparable projects in other countries. The comprehensive research and monitoring information available of the impacts of warm cooling waters on Lake Druksiai and on recipients in other countries will also be utilized. The possibilities for the utilization of the thermal energy in the cooling water will be examined.

The wastewater load and radioactive discharges to the lake occurring during the operation of the new NPP will be presented. The impacts of wastewater on water quality and biology, as well as on the fish population and fishing industry, will be assessed based on the existing extensive research data.

A detailed description of the methodology for prediction and evaluation of the impacts on this environmental component due to operation of the new NPP will be presented in the EIA report.

7.1.3 Mitigation measures

The mitigation measures will be presented in the EIA report. Typical mitigation measures are to design and place the cooling water outlet correctly and to prevent radioactive releases and accidental spills of polluting substances into the water bodies.

7.2 CLIMATE AND AIR QUALITY

7.2.1 Present state of the environment

7.2.1.1 Climate

The region concerned is located in the continental East Europe climate area. One of the main features of the climate in the region is the fact that no air masses are formed over this area. Cyclones are mostly connected with the polar front and determine continuous movement of air masses. The cyclones formed over the medium latitudes of the Atlantic Ocean move from the west towards the east through Western Europe and the new NPP region is often located at the intersection of the paths of the cyclones bringing humid maritime air. The variation of maritime and continental air masses is frequent, therefore the climate of the region can be considered as a transient climate from the maritime climate of Western Europe to the continental climate of Eurasia.

In comparison with other Lithuanian areas, the new NPP area is characterized by big variations of air temperature over the year, colder and longer winters with abundant snow cover, and warmer, but shorter summers. Average precipitation is also higher.

Precipitation and snow cover

Monthly averages of precipitation for the new NPP region are given in the Table 7-8. Average annual amount of precipitation in the new NPP region is 638 mm. About 65% of all precipitation takes place during the warm period of the year (April–October), and about 35% during the cold period (November–March).

Table 7-8. Monthly averages of precipitation (mm) for the new NPP region.

Meteorological station and observation period	Month (s)												Total for months		
	01	02	03	04	05	06	07	08	09	10	11	12	01-12	11-03	04-10
Dukstas, 1961–1990	32	25	28	43	58	69	75	66	64	50	42	40	592	167	425
Utena, 1961–1990	39	31	37	47	53	69	73	75	66	50	57	53	650	217	433
Zarasai, 1961–1990	45	36	39	42	59	72	75	66	66	55	60	56	671	236	435
INPP, 1988–1999	41	41	46	33	55	84	60	64	70	66	58	57	676	244	432
INPP, 2000–2005	46	46	36	40	52	92	78	68	38	75	59	46	676	233	443

The snow cover in the region lasts about 100–110 days per year. Average thickness of snow cover is 16 cm, and maximum is 64 cm. Density of snow cover gradually increases from 0,2 to 0,5 g/cm^3 in the middle of March. Absolute maximum of recorded weight of snow cover is 120 kg/m^2.

Wind

Western and southern winds dominate. The strongest winds have western and south-eastern directions. The average annual wind speed is about 3,5 m/s, and maximal (gust) speeds can reach 28 m/s. No-wind conditions are observed on the average of 6 % of the time and last no more than one day (24 hours) in the summer, and no more than two days in the winter. Wind rose at new NPP region is based on local wind measurements and is presented in Figure 7-5.

Winds with speeds below 7 m/s dominate – recorded events constitute more than 90% of the total number of observations. Recorded events with wind speeds above 10 m/s are not frequent – less than 10 events per year.

Calculated average wind pressure is 0,18 kPa and pulsation component of wind load is 0,12 kPa. With the reliability coefficient 1.4, calculated value of uniform wind load is 0,42 kPa and extreme wind load (with frequency 1 per 10 000 years) is 1,05 kPa with the reliability overloading coefficient 2,5 (*Almenas et al. 1998*).

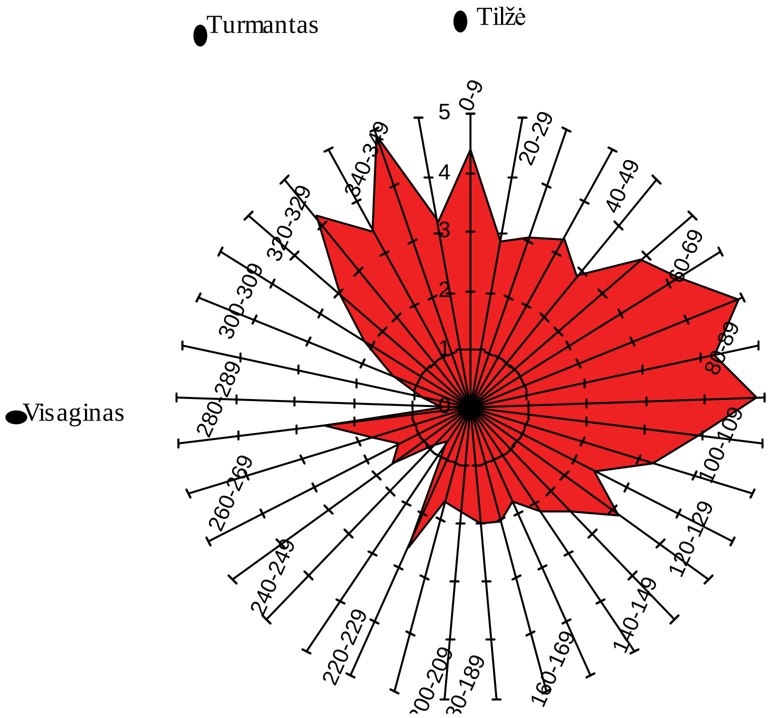


Figure 7-5. Wind rose at the new NPP region (wind direction off the new NPP).

Extreme events (spouts) are rare in the vicinity of Ignalina site. During a storm in 1998 a wind speed of 33 m/s was recorded. Spouts in the vicinity of the new NPP have not exceeded class F-2 according to Fujita classification. The season of spouts begins at the end of April and ends in the first half of September. The direction of spout motion is from south-west to north-east in 75% of the cases. The average length of spout shift trajectory is 20 km and the length varies from 1 to 50 km. Average width of the spouts is 50 m with variations from 10 to 300 m. Calculated maximum spout velocity with a frequency of 1 in 10000 years is 39 m/s (*Almenas et al. 1998*).

Insolation

Average annual duration of sunshine in the region is about 1710 hours (42% of the maximum possible duration of the earth's surface insolation by the sun). June is the sunniest month: the amount of sunshine in June is about 280 hours (58% of the possible duration). The shortest period of sunshine because of cloudy weather is observed in December, which is about 20 hours (12% of possible duration).

Average annual cloudiness in region is about a force 7. In December it increases to a force 8,5 and in May it decreases to a force 6,5. The average annual amount of cloudy days (175) is considerably larger than the clear ones (*Almenas et al. 1998*).

Temperature

Monthly average temperatures in the new NPP region are given in the Table 7-9.

Average calculated air temperatures of the coldest five-day period are –27 ºC. Absolute maximum of recorded temperature is 36 ºC and absolute minimum is –40 ºC. Absolute maximum of calculated temperature with a frequency of 1 in 10 000 years is 40,5 ºC and absolute minimum of calculated temperature with a frequency of 1 in 10 000 years is –44,4 ºC (*Almenas et al. 1998*).

Table 7-9. Monthly average temperatures (°C) for the new NPP region.

Meteorological station and observation period	Month												01–12
	01	02	03	04	05	06	07	08	09	10	11	12	Average
Dukstas, 1961–1990	-6,8	-5,9	-1,9	5,2	12,1	15,5	16,8	15,9	11,2	6,2	0,9	-3,8	5,5
Utena, 1961–1990	-6,0	-5,2	-1,2	5,5	12,2	15,6	16,8	15,9	11,4	6,6	1,4	-3,2	5,8
INPP, 1988–1999	-2,5	-2,2	0,3	6,6	12,4	16,5	17,9	16,5	11,3	6,0	-0,1	-3,1	6,6
INPP, 2000–2005	-3,6	-4,4	0,7	7,4	12,4	15,2	19,1	17,3	11,8	6,4	1,6	-3,3	6,7

Atmospheric pressure

Normal range of atmospheric pressure is 994 hPa. The greatest values of twenty-four-hour atmospheric pressure are usually in winter and vary from 1010 to 1027 hPa. The smallest values of twenty-four-hour atmospheric pressure are observed in summer and vary from 970 to 985 hPa. The oscillations of twenty-four-hour amplitude of atmospheric pressure vary from 15 to 25 hPa.

Humidity

Average relative humidity of air reached 80%, and about 90% in winter. A minimum relative humidity (53–63%) is observed in June, and a maximum – in January.

The frequency of the storms with lightnings

Average number of storms with lightnings is 11 per year. Four storms monthly are usually observed in July–August and 1–2 storms in other relatively warm months.

Average duration of storm is 2 hours and a maximum 4 hours. Average duration of storm with lightnings in the course of year is about 22 hours.

Fogs

In the new NPP area, fog can be observed any day of the year. Average number of foggy days is 45. Fog absorbs different impurity (noxious gases, smoke, dust) and, combined with high humidity, increases corrosion intensity, aggravating visibility and impeding transportation. Average duration of fog in the course of a month is from 4 to 29 hours and in the course of year is about 173 hours. During the cold period total duration of fog varies between 92 to 106 hours, and during the warm period it is about twice lower, which is 49–68 hours.

Black ice, hoarfrost, ground freezing

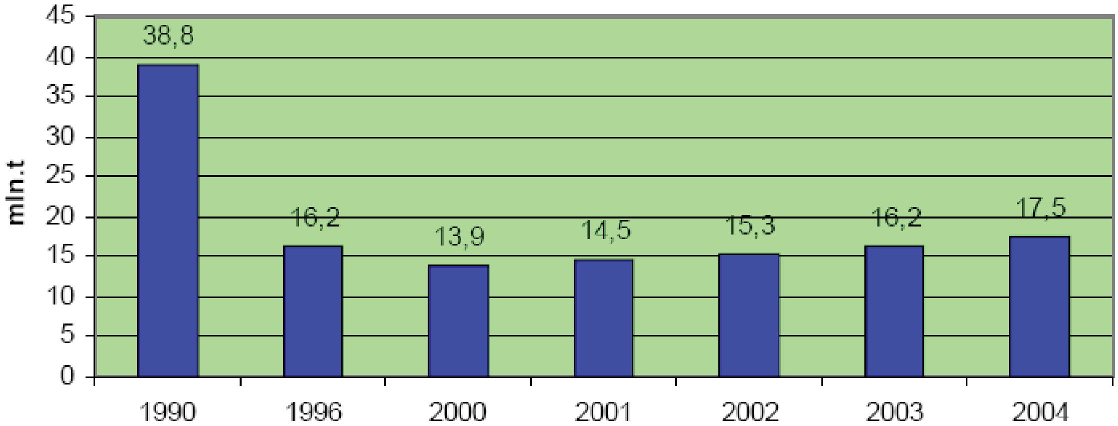
There are about 15 days with glazed frost or ice-crusted ground, 14 days with hoarfrost and 18 days with blizzard per year. The length of hoarfrost threads reaches 50 mm.

The freezing of the ground usually begins in the first part of December and lasts to the middle of April. The average depth of the frost line reaches about 50 cm, and with a maximum extending to 110 cm depending on the composition of the ground and its humidity.

7.2.1.2 Background contamination of the ambient air and greenhous gases

Information about the background contamination of the ambient environment and greenhouse gases, presented in this chapter, will be based on the reports from the investigations on pollutant concentrations in the atmosphere (ref. Environmental protection agency website http://aaa.am.lt/) and on the Report on Implementation of the National Sustainable Development Strategy for 2003–2004. While evaluating potential impact of proposed economic activity on ambient air, present background contamination of the air and greenhouse gases will be taken into consideration in the EIA report. General information about potential changes in background contamination levels due to shut down of the Ignalina NPP and in case the required amount of electricity will be produce by organic fuel burning in other Lithuanian power plats, and since new NPP is in operaion will also be presented in the EIA report.

The greenhouse gases emission into atmosphere in 1990-2001 period was constantly decreasing. In 2001 the amount of released greenhouse gases made less than one third of the amount, released in 1990. However, since 2002 the greenhouse gases emission is increasing as a result of the increased energy demand (Figure 7-6). Despite this, the total amount of the greenhouse gases emission (in terms of CO_2 equivalent) makes only about 4 t/man for the moment in Lithuania and this result is among the lowest values for the European Countries (3-15 t/man) (*Report on Implementation of the National Sustainable Development Strategy for 2003–2004*).



7-6 pav. Trends in atmospheric greenhouse gases emission (in terms of CO_2 equivalent) in Lithuania.

As can be seen from the Figure 7-6, in 2003–2004 the total amount of greenhouse gases emission in Lithuania increased from 15.3 to 17.5 mln tonn, what makes about 14.2 %. Since Lithuanian Gross Domestic Product (GDP) during these years increased by 18.2 %, the greenhouse emission grows more rapidly as it was forseen in the National Sustainable Development Strategy (the ingrowth of emissions should be lower than the growth of GDP by half). However, that doesn't make any difficulties for Lithuania to keep the Kyoto protocol requirements. The difficulties may arise after the year 2010, when Ignalina NPP Unit 2 will be shut down and the demand of energy have to be compensated by burning organic fuel.

Radioactive emissions

Permission to release radionuclides from the nuclear installations into environment is issued by the Ministry of Environment according to the requirements of the normative document LAND 42-2001 "On the Restrictions on the Release of Radionuclides from Nuclear Installations and Procedure for the Authorisation of Release of Radionuclides and Radiological Monitoring" (*State Journal, 2001, No. 13-415; 2005, No. 142-5136*). According to the existing rules, the Ministry of Environment issues permissions for Ignalina NPP for releases of radioactive material into environment. Radioactive emissions from Ignalina NPP into atmosphere are continuously monitored. The information on radionuclides and activities that have been actually released from existing Ignalina NPP is presented in Table 7-10 and Table 7-10 (*INPP Report ПТОот-0545-14, 2007*)

It should be noted that these existing releases of certain radionuclides are 100 and more times less than permissible values indicated in the valid permission of Ministry of Environment.

Table 7-10. Activity (10^5 Bq) of aerosols released from Ignalina NPP into atmosphere during 2000-2006.

Nuclide	Year							Annual limit value
	2000	2001	2002	2003	2004	2005	2006	
Na-24	0	14,8	15,2	529	1840	0	0	463
Cr-51	0	312	124	190	86,2	0,02	365	682000
Mn-54	3120	1790	949	1430	1090	333	560	96200
Co-58	55,6	98,9	42,0	112	64,4	27,7	39,7	73400
Fe-59	441	599	238	318	52,5	105	226	491000
Co-60	4680	2990	1920	2260	2320	1030	1020	2880000
Zn-65	0	27,0	4,74	18,5	1,92	160	234	8320
As-76	0	0	0	0	0	0	0	103000
Sr-89	438	332	483	587	618	553	287	61100
Sr-90	450	421	587	453	597	559	592	53800
Sr-91	0	0	0	0	0	0	0	25900
Zr-95	486	325	87,9	120	91,2	0	2,62	733000
Nb-95	902	1430	421	458	431	13,4	140	487000
Mo-99	0	0	0	0	44,4	44,4	41,2	146000
Ru-105	0	0	0	0	0	0	0	125000
Sb-122	0	0	0	0	0	0	0	27700
Sb-124	0	0	0	0	0	0	0	147000
I-131	20,5	166	671	138	281	49,9	1240	9870000
I-132	0	0,40	12,3	0	0,41	0		9580
I-133	0	15,2	0,16	342	104	1430	1100	19800
Cs-134	127	178	279	147	133	12,2	22,7	13300
I-135	0	0	0	0	0	0	0	86700
Cs-136	0	0	0	0,40	0,25	0,05	0	14800
Cs-137	1320	1770	1170	925	661	1280	1020	1390000
Ba-140	0	0	0	0	0	0	0	10800
La-140	0	2,70	0	0	0	0	0	77200
Ce-144	0	0	0	0	0	0	0	78600
W-187	0	0	0	0	0,04	0	0	56400
Viso	12000	10500	7010	8030	8420	5590	6910	

Table 7-11. Activity (10^{10} Bq) of noble gases released from Ignalina NPP into atmosphere during 2000-2006.

Nuclide	Year							Annual limit value
	2000	2001	2002	2003	2004	2005	2006	
Ar-41	3630	6180	3780	3220	1430	1340	961	900000
Kr-85m	52,9	61,1	200	196	90,3	145	49,6	45000
Kr-87	106	25,9	120	22,6	45,1	28,1	0	21500
Kr-88	43,7	27,4	117	57,4	34,8	24,8	0	14700
Xe-133	1530	2640	4550	2740	4090	5110	1780	360000
Xe-133m	7,40	2,60	17,4	11,8	15,5	175	0	2730
Xe-135m	195	56,2	143	0	33,7	0	0	8000
Xe-135	219	552	719	470	369	625	332	30600
Xe-138	343	94,7	430	0	45,1	0	0	6810
Viso	6130	9640	10100	6720	6160	7440	3120	

Radioactive emissions from the existing Ignalina NPP and caused doses to population are summarized in Table 7-12 (*INPP Report ПТОот-0545-14, 2007*). The actual annual dose to critical group members of the population due to operation of the Ignalina NPP is about 1 % of the established limit value of 0,1 mSv/year = 100 µSv/year.

Table 7-12. Annual dose to critical group members of the population (during 2000-2006) due to radioactive emissions from Ignalina NPP.

	Annual dose to critical group members of the population, µSv			
Year	**Noble gases**	**Aerosols & I-131**	**Total dose, µSv**	**% of dose limit (0,1 mSv)**
2000	0,041	0,196	0,237	0,24
2001	0,065	0,154	0,219	0,22
2002	0,047	0,172	0,219	0,22
2003	0,035	0,110	0,145	0,15
2004	0,017	1,878	1,894	1,89
2005	0,016	1,109	1,126	1,13
2006	0,011	1,377	1,388	1,39

7.2.2 Assessment of impacts on air quality

Amounts of radioactive emissions and other pollutants released to atmosphere, which are generated during construction and exploitation of the new NPP, will be presented in the EIA report. Based on the available data, impacts on environment and population will be assessed.

The nuclear power plant during its normal operation will generate no exhaust gas emissions with an exeption of emergency diesel generator, which is used for power supply under accidental conditions. Positive impact on air quality could be avoiding emissions for production of a similar amount of electricity burning fossil fuels.

Amounts and impacts of radioactive releases and pollutant emissions to atmosphere in emergency situations will be evaluated in the EIA report.

Information on potential air pollution (t/year) and emission trends from burning organic fuel in Lithuanian power plants to ensure required power supply will be presented in the EIA report:

- Air pollution before Ignalina NPP shutdown;
- Air pollution after Ignalina NPP shutdown;
- Air pollution with the start of the new NPP.

Air pollution taking into account background contamination will be evaluated in the EIA report.

The avoided flue gas emissions (SO_2, NO_x, particulate emissions, CO_2) will be estimated by assuming that the amount of electricity equal to the production of the new NPP would be produced in Lithuania and imported.

A detailed description of the methodology for prediction and evaluation of the impacts on this environmental component due to operation of the new NPP will be presented in the EIA report.

7.2.3 Mitigation measures

The mitigation measures will be presented in the EIA report. Typical mitigation measure is applying appropriate air pollution control technology.

7.3 GROUNDWATER

7.3.1 Present state of the environment

The upper part of the geological-hydrogeological section in the new NPP environs makes 4 main aquifers (see Chapter 7.1.1.1) – 1) an only locally occurring shallow water-table aquifer, whose water table in certain parts of the new NPP area is at land surface; 2) closely related to the water-table aquifer two (1st and 2nd) intramorainic aquifers, occurring at a depth of 10 and 20–30 m correspondingly; 3) at the depth of 40–50 m occurring the main Devonian (D3šv+D2up) aquifer (aquifers system) which is recharged by above-laying aquifers and which is used for Visaginas town, INPP and other local users water supply.

The general direction of the groundwater flow in the new NPP area is S–N, NE; the watertable of the first, unconfined aquifer has a more complicated structure: a part of this water flows from the new NPP area into E direction, another part – into W direction; the groundwater level of the main, D3šv+D2up aquifer and 2nd, intramorainic aquifer is lowered by the Visaginas wellfield into opposite, S direction. The results of the previous simulation show that this groundwater levels inversion can be even more significant in the future.

7.3.2 Assessment of impacts on groundwater

In order to evaluate potential impact on groundwater a detail assessment of the site for construction of the new power plant will be presented in the EIA report. The greatest attention will be paid to the shallow groundwater and potential impact on it caused by the new power plant construction and operation.

Deeper confined aquifer layers are used for municipal and privat drinking water supply in the new NPP region. Potential impact on quality of the drinking water during construction and operation of the new NPP will be analysed in the EIA report.

7.3.3 Mitigation measures

Preventive measures against groundwater and water wells contamination will be provided and justified in the EIA programm. Typical groundwater impact mitigation or prevention measure is e.g. constructing all potential sources of harmful substance leaks (eg. oil containers, transformers etc.) into secondary protection basins.

7.4 SOIL

7.4.1 Present state of the environment

According to Lithuanian hygienic norm HN 60:2004 (*State Journal, 2004, No. 41-1357*) soil is defined as an upper loose layer of earth, which is formed from the native rock under influence of soil formation processes (a complex of impacts from water, air, bio-organisms) and is characterized by its potential productivity. The territory of the new NPP area has been affected in the past because of industrial activity (INPP). The construction of the INPP Unit 3 has been started at the end of the 1980´s. Construction materials and some equipment have been stored on the site foreseen for INPP Unit 4. Now the constructions of INPP Unit 3 are dismantled and the uncompleted buildings are demolished, the stored materials are taken away. Recently the territory was levelled and covered with a filling, thus soil in this area is absent.

According to the Technical Construction Regulation STR 1.04.02:2004 (*State Journal, 2004, No. 25-779*) ground is defined as naturally or artificially thickened or loosen sediments, deposits or other type of the earth particles, which natural or artificially formed layer is an object of investigation, evaluation and application for construction purposes – as a basement for existing or projected building or underground medium of the construction; or as an object of construction underground activities or ground construction; or as medium of the geological events and processes important for construction activities. The new NPP site is almost entirely covered by filler soils (tplIV). At locations of former buildings there are a lot of technogenic formations (tIV) consisting of construction scrap and abandoned underground communication cables. Filler soils consist of clay loam with pebble and gravel, sand at places with organic remains. Layer thickness is 2–10 m (UAB “Hidroprojektas”, 2006). The information about chemical composition of the filler soil, its resistance to pollution, possible accumulation of pollutants in the soil and their migration will be presented in the EIA report.

According to the Ignalina NPP monitoring program, samples of the soil in the region of Ignalina NPP are continuously monitored. The information on detected radionuclides and their radioactivities is presented in Table 7-13 (*INPP Report ПТОот-0545-14, 2007*).

Table 7-13. Specific activity of the radionuclides in the soil of Ignalina NPP region.

Year	Specific activity in the soil, Bq/kg								Total (except Ra, Th, K)	
	Cs-137	Cs-134	Mn-54	Co-60	Sr-90*	Ra-226	Th-228	K-40	Bq/kg	Bq/m^2
1999	7,89	1,28	0,17	0	<20,0	21,9	33,1	807	9,35	170
2000	5,10	1,50	0,10	0	<20,0	31,4	30,2	618	6,70	339
2001	4,89	1,36	0,08	0	<20,0	42,6	31,9	606	6,34	320
2002	7,02	1,65	0	0	<20,0	45,9	45,2	850	7,36	154
2003	3,70	1,03	0	0	<1,53	22,9	29,3	596	6,26	131

2004	4,98	0,43	0,08	0	2,08	34,2	26,8	549	7,47	158
2005	3,38	0	0	0	1,49	13,8	18,6	462	4,87	31,3
2006	3,38	0	0	0,05	0	22,0	25,6	613	3,43	74,8

* – since 2003 detection methodology of Sr-90 has been improved.

7.4.2 Assessment of impacts on soil

The main impacts on soil will occure during the construction period and it will be typical as of any construction project. These include a temporary accumulation of upper soil layer and equipment, generation of dust from the movement of heavy vehicles and also from earth movements (dust clouds during dry periods). These impacts will be temporary. It is expected that during normal operation of the new NPP the radiation doses due to radionuclides in the soil will be negligible. The area, depth and volume of the fertile soil layer, which have to be removed during proposed economic activity, its temporary storage location and period and etc. will be presented in detail in the EIA report. The potential soil pollution (chemical, radiological, etc.) due to proposed economic activity, accumulation and migration of pollutants, physical (mechanical) impact on soil will be evaluated in the EIA report and prognosis of possible changes of qualitative soil factors, resistance and other parameters will be presented.

A detailed description of the methodology for prediction and evaluation of the impacts on this environmental component due to operation of the new NPP will be presented in the EIA report.

7.4.3 Mitigation measures

Measures to mitigate soil pollution and physical (mechanical) impacts on soil will be presented in the EIA report. Construction will be performed using techniques designed to minimize the potential erosion of the topsoil and to prevent leaking of harmful substances like fuel and oils from the machines. Detailed information about possible impact mitigation measures will be presented in the EIA report.

7.5 GEOLOGY

7.5.1 Present state of the environment

7.5.1.1 Precambrian crystalline basement

The new NPP area is located in the western margin of the East European Platform. It is located in the junction zone of two major regional tectonic structures: the Mazur-Belarus Rise and the Latvian Saddle that makes the structural pattern of the area rather complicated. The contemporary relief of the crystalline basement reflects movements over period of 670 million years. Several tectonic structures (blocks) of the lower order are distinguished in the surface of the Precambrian crystalline basement: the North Zarasai Structural terrace, the Anisimoviciu Graben, the East Druksiai Uplift, the Druksiai Depression (Graben) and the South Druksiai Uplift. The North Zarasai Structural terrace, the Anisimoviciu Graben and the East Druksiai Uplift are related to the Latvian Saddle. The South Druksiai Uplift belongs to the Mazur-Belarus Rise and the Druksiai Depression (Graben) is located within the junction zone of the two aforementioned regional structures (*Marcinkevicius et al. 1995*).

The crystalline basement is buried to depth at about 720 m from the Earth's surface. It is comprised of the Lower Proterozoic rocks predominantly of biotite and amphibole composition: gneisses, granite, migmatite, etc. The thickness of the sedimentary cover in the region of the new NPP varies in a range of 703–757 m. Pre-Quaternary succession is represented by the Upper Proterozoic Vendian complex, overlain by sediments of the Paleozoic systems. The Vendian deposits are represented by a succession of gravelstone, feldspar-quartz sandstone of different grain size, siltstone and shale. The Paleozoic section comprises the successions of the Lower and Middle Cambrian, the Ordovician, the Lower Silurian and the Middle and Upper Devonian sediments (Figure 7-7 and Figure 7-8).

The Lower Cambrian is represented by quartz sandstone with inconsiderable admixture of the glauconite, siltstone and shale. The sandstone is of the different grain size with the fine-grained and especially fine-grained sandstone predominating. The Middle Cambrian comprises the fine-grained and especially fine-grained sandstone. The Ordovician is composed of interbedded marlstone and limestone. The Lower Silurian is composed of dolomitic marlstone and dolomite. The Middle Devonian – of gypsum breccia, dolomitic marlstone and dolomite as well as interbeds of the fine-grained and very fine-grained sand and sandstone, siltstone and claystone; the Upper Devonian – of fine-grained and very fine-grained sand and sandstone, interbeds of the siltstone and claystone. The Vendian deposits vary in thickness from 135 to 159 m; the total thickness of the Lower and Middle Cambrian succession reaches 93–114 m, the thickness of the Ordovician varies in a range of 144–153, the Silurian – 28–75 m and the total thickness of the Devonian sediments reaches 250 m (*Marcinkevicius et al., 1995*).

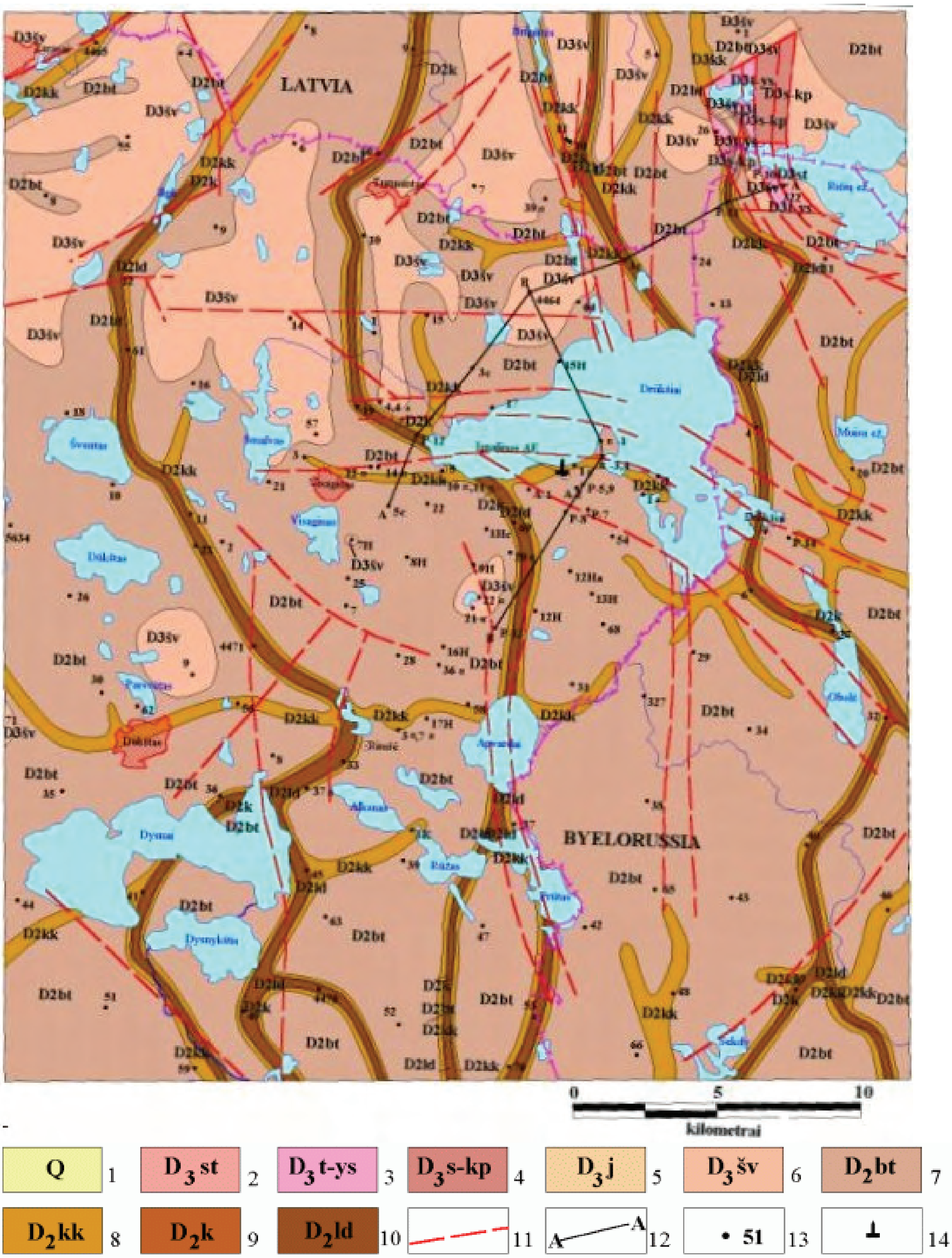


Figure 7-7. Pre-Quaternary geological map of the new NPP region (*Marcinkevičius at al., 1995*): 1 – Quaternary deposits (on the sections); Upper Devonian formations: 2 – Stipinai; 3 – Tatula–Istra; 4 – Suosa–Kupiskis; 5 – Jara; 6 – Sventoji; Middle Devonian formations: 7 – Butkunai; 8 – Kukliai; 9 – Kernave; 10 – Ledai; 11 – Fault; 12 –Line of geological-tectonical cross-section; 13 – Borehole; 14 – INPP and the new NPP.

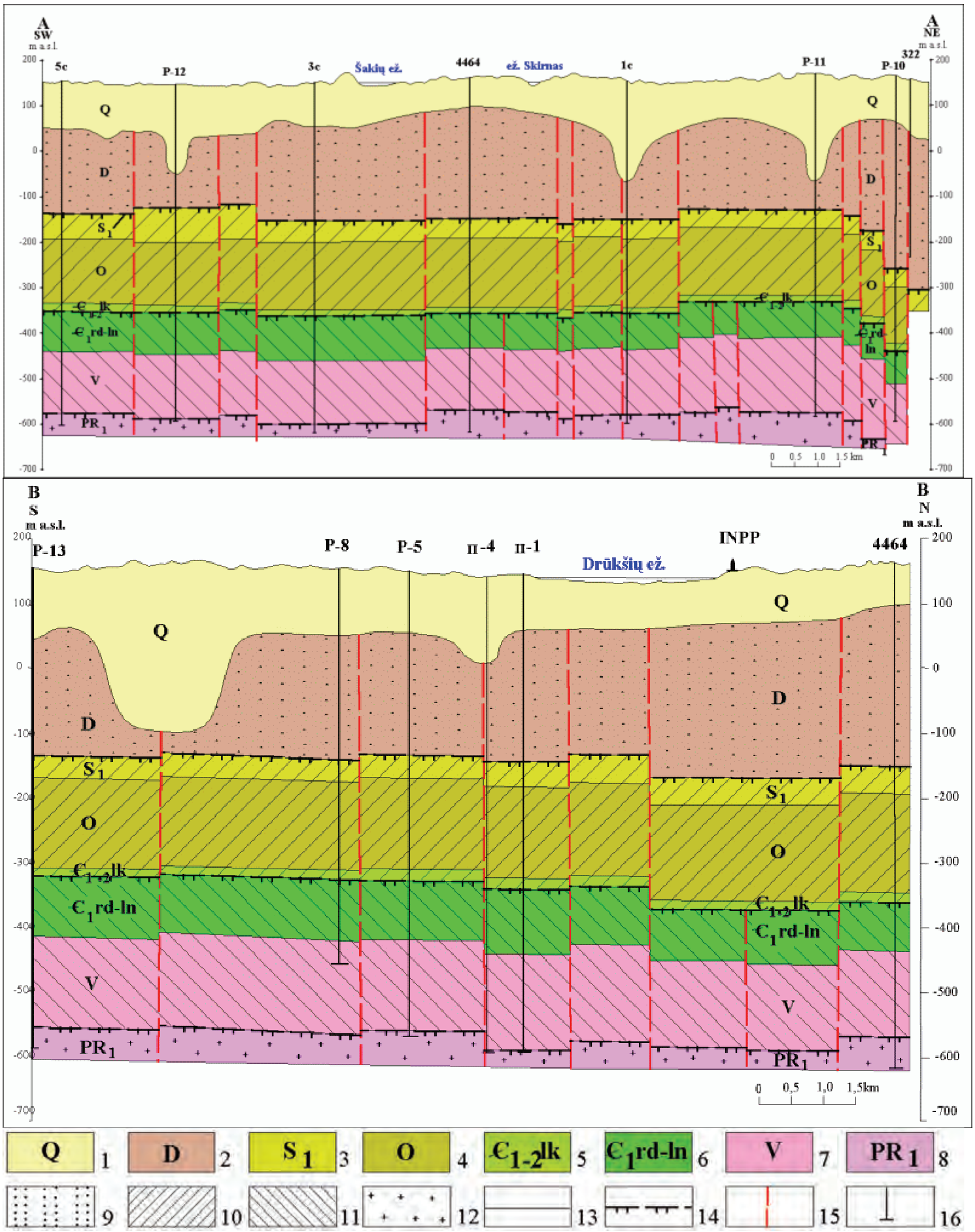


Figure 7-8. Geological-tectonic cross-sections of the new NPP region (*Marcinkevičius at al., 1995*): 1 – Quaternary: till, sand, silt and clay; 2 – Middle and Upper Devonian: sand, sandstone, siltstone, clay, domerite, dolomite, breccia; 3 – Lower Silurian: domerite, dolomite; 4 – Ordovician: limestone, marl; 5 – Lower and Middle Cambrian Aisciai Series Lakajai Formation: sandstone; Lower Cambrian Rudamina–Lontova Formations: argillite, siltstone, sandstone; 7 – Vendian: sandstone, gravelite, siltstone, argillite; 8 – Lower Pro-terozoic: granite, gneiss, amphibolite, mylonite; Structural complexes: 9 – Hercynian; 10 – Caledonian; 11 – Baikalian; 12 – Crystalline basement; 13 – Border between systems; 14 – Border between complexes; 15 – Fault; 16 – Borehole.

7.5.1.2 Quaternary cover

Sub-Quaternary relief of the area is highly dissected by paleoincisions (Figure 7-9). The thickness of the Quaternary cover varies from 62 up to 260 m.

The Quaternary deposits are of Pleistocene and Holocene age. The area is made up of glacial deposits (till) of the Middle Pleistocene Dzukija, Dainava, Zemaitija and Medininkai Formations, and of the Upper Pleistocene Upper Nemunas Formation (Gruda and Baltija). The intertill glaciofluvial (sand, gravel, cobble, pebble) and glaciolacustrine (fine-grained sand, silt, clay) sediments are detected in the area. The thickness of the intertill deposits varies from 10–15 m up to 25–30 m (Figure 7-10). The interstadial deposits are composed of very fine-grained and fine-grained sand, silt and peat (Figure 7-12 and Figure 7-13). The Holocene deposits are represented by alluvial, lacustrine and bogs sediments. Alluvial sediments are variously grained sands with 1–1.2 m thick organic layers. The lacustrine sediments (fine-grained sand, clay, silt) reach a thickness of 3 m. The thickness of the peat is 5–7 m (*Marcinkevicius et al. 1995*).

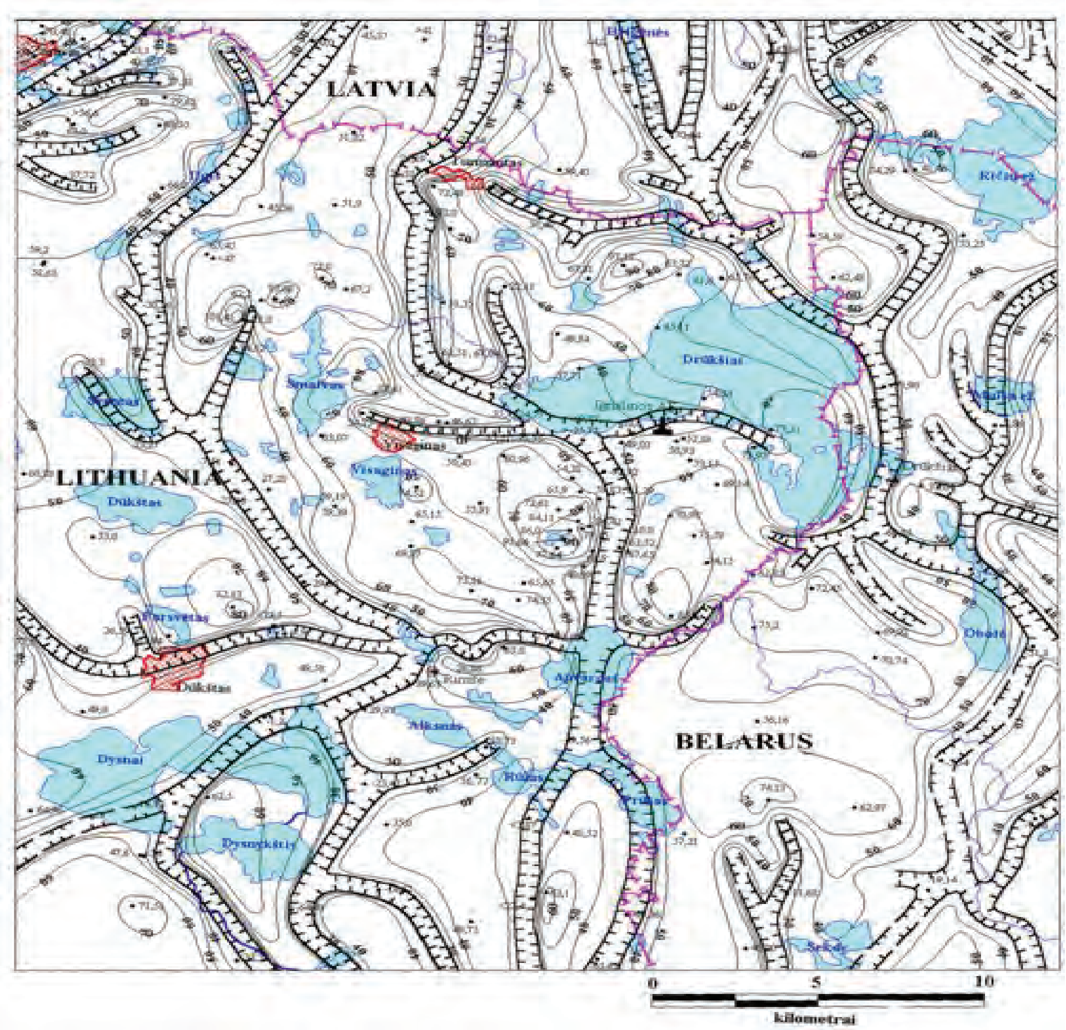


Figure 7-9. Scheme of sub-Quaternary surface of the new NPP area (*Marcinkevičius at al., 1995*): 1 – Paleoincision; 2 – Isohypse of pre-Quaternary surface, m; 3 – Boreholes and the absolute depth of the pre-Quaternary surface: 4 – INPP and the new NPP.

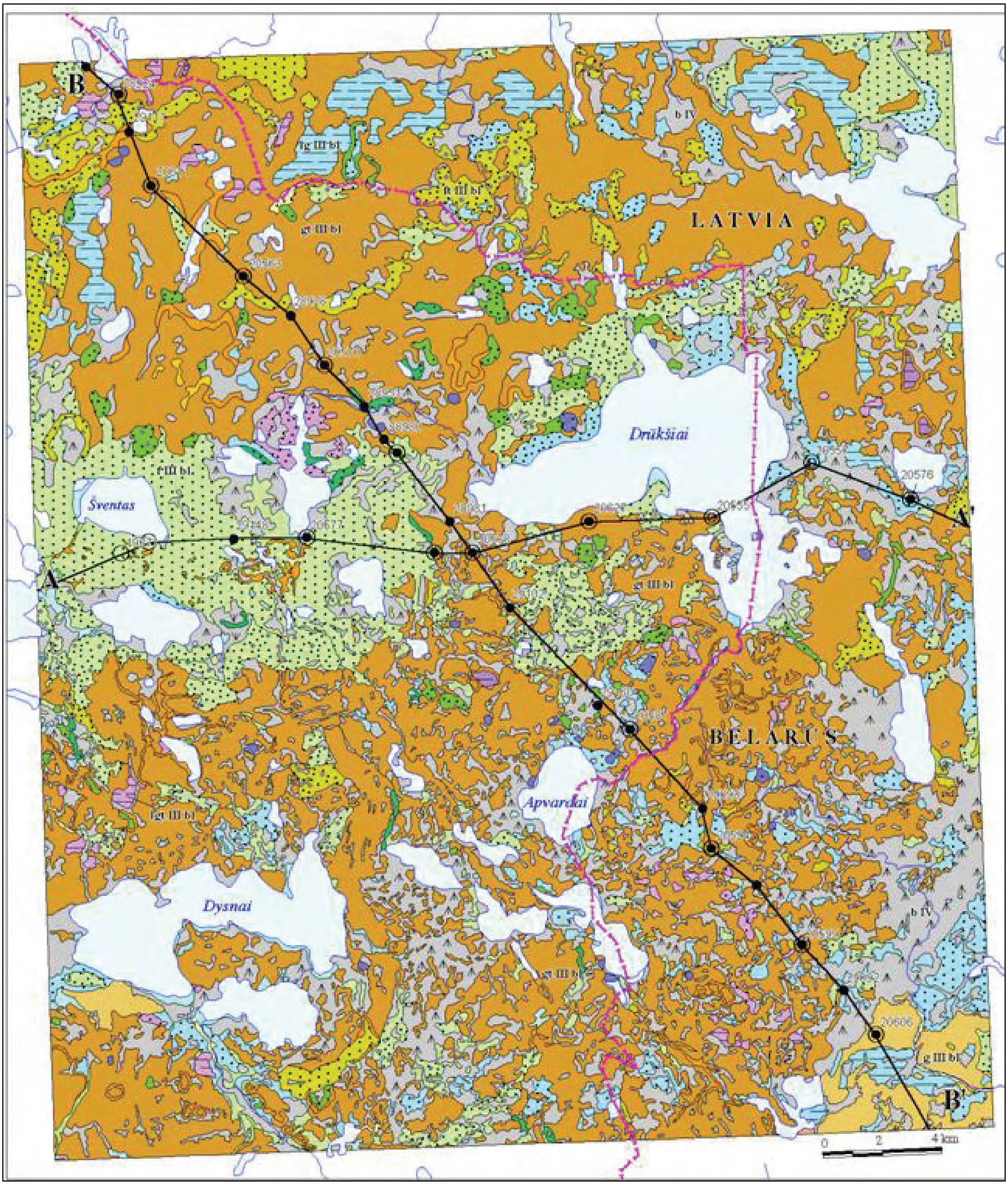


Figure 7-10. Quaternary geological map of the new NPP area (original scale 1:50 000, author: R. Guobyte (*Marcinkevicius et al. 1995*)); legend see in Figure 7-11.

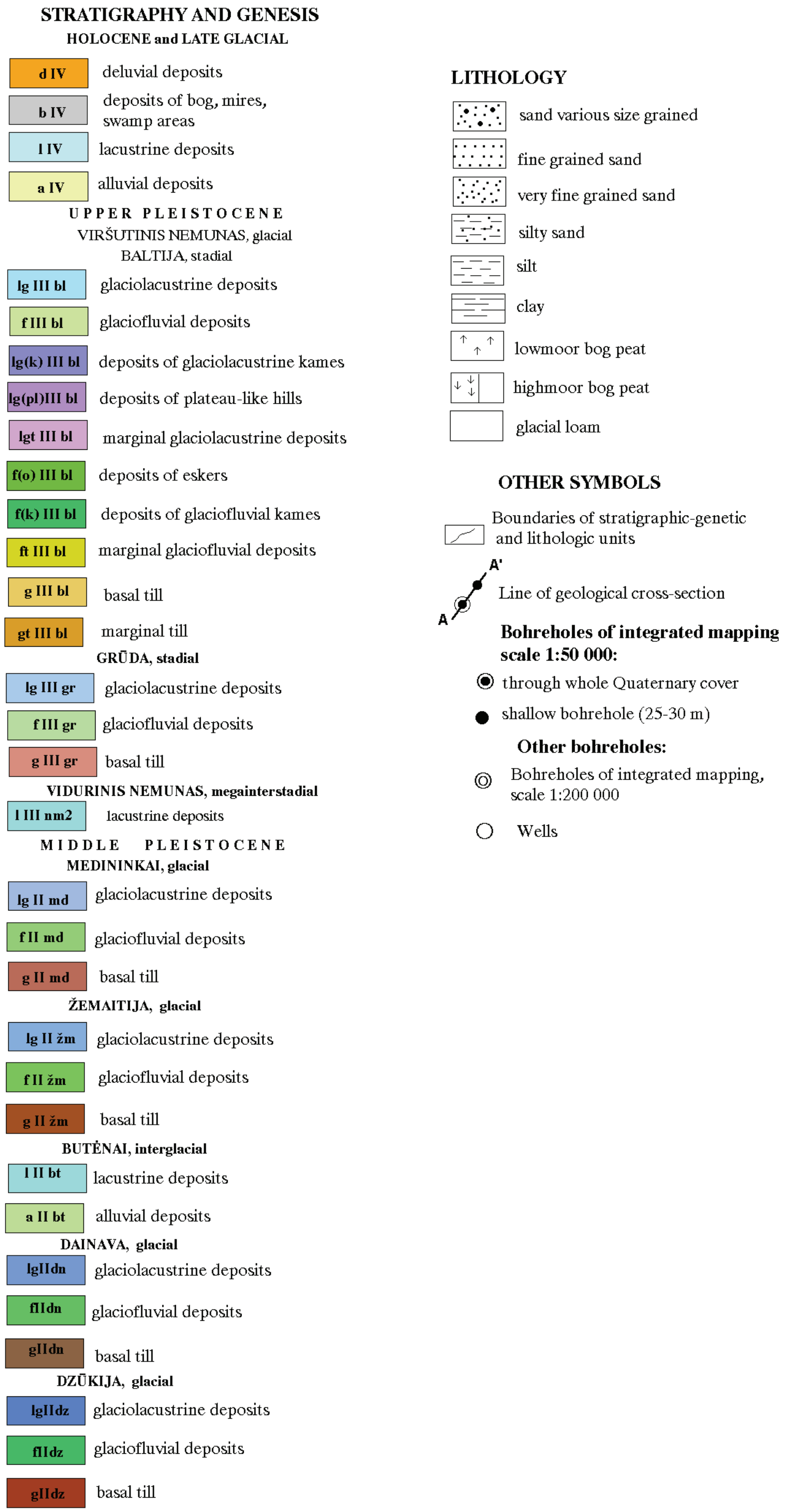


Figure 7-11. Legend for Quaternary geological map and geological cross-sections of the new NPP region.

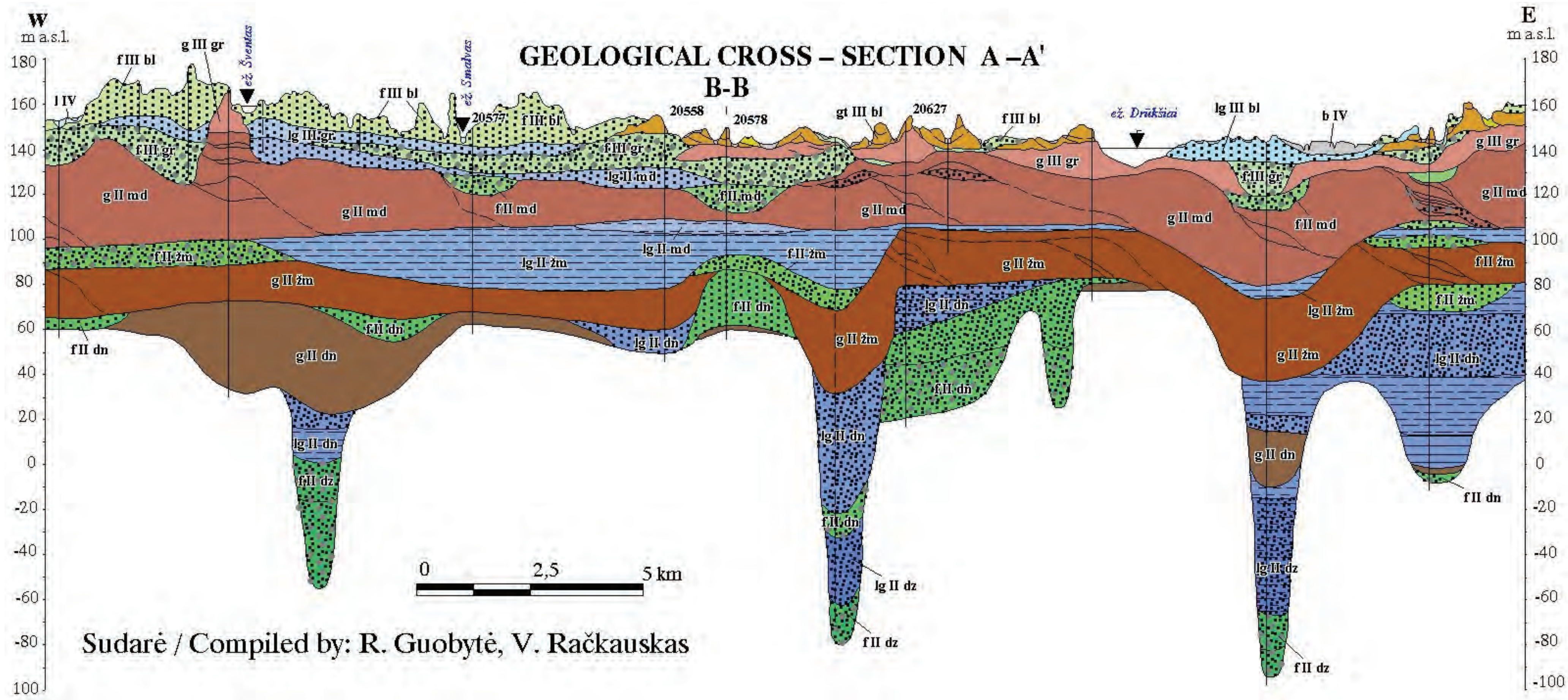


Figure 7-12. Quaternary geological cross-section A-A of the new NPP area (original scale 1:50 000, authors: R. Guobyte, V. Rackauskas (*Marcinke-vicius V. et al., 1995*)); legend see in Figure 7-11.

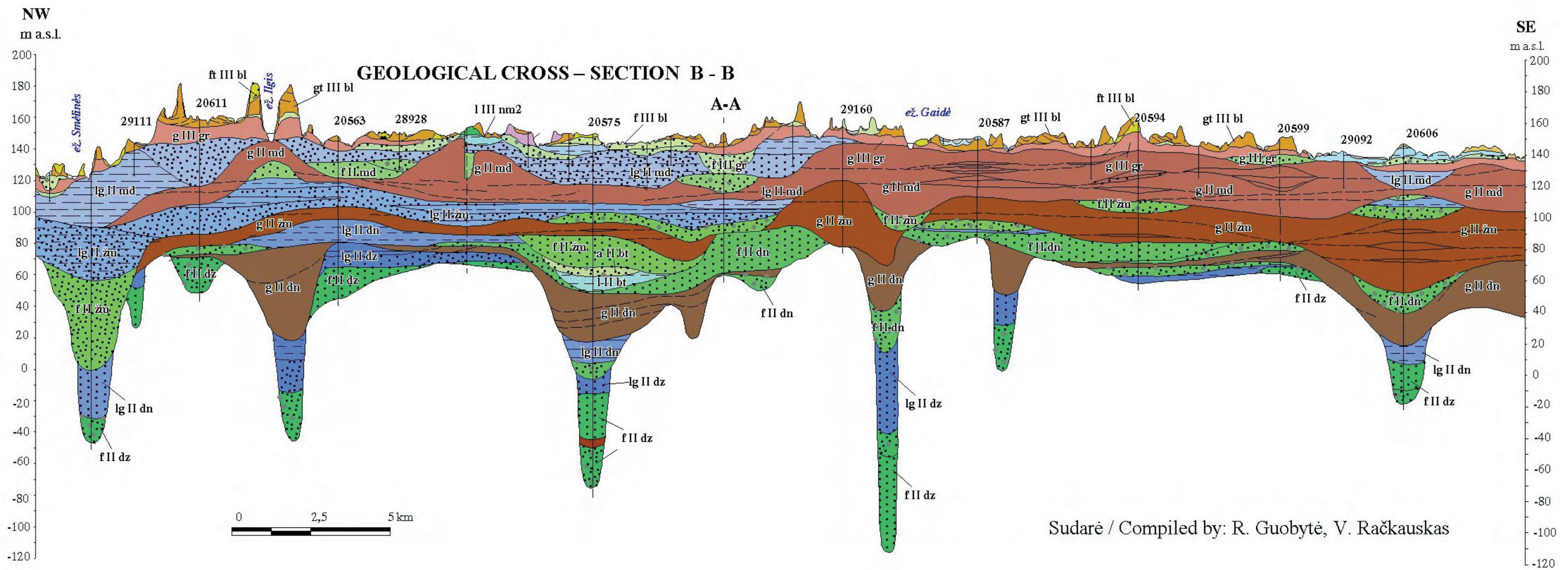


Figure 7-13. Quaternary geological cross-section B-B of the new NPP area (original scale 1:50 000, authors: R. Guobyte, V. Rackauskas (*Marcinke-vicius V. et al., 1995*)); legend see in Figure 7-11.

7.5.1.3 Tectonic faults

Two types of faults can be distinguished in the new NPP area, i.e. the oldest pre-platform and younger platform features. The faults detected in the sedimentary cover are oriented N-S, W-E, NW-SE and NE-SW. The faults of the Druksiai Depression (Graben) and Anisimoviciu Graben are the most distinct tectonic features recognized in the study area. The Druksiai Depression (Graben) is as wide as 3–5 km; it consists of 0.5–1.5 km wide structural domains. The middle part of the graben is uplifted, representing the horst. The bounding faults exceed 20 km in length. The amplitude of the faults separating the horst is in the range of 25–55 m, the amplitude of the faults bounding the depression in the south and the north is about 10–20 m. The Anisimoviciu Graben is dissected by arcuate-shaped (in plan view) faults spaced at 0.5–0.7 km; the blocks stepping down to the northeast.

The length of the faults is of about 10 km; the amplitude reaches 15–60 m. Total amplitude of the faulting with respect to the top of the Silurian is about 180 m. The faults striking N-S are common in the North Zarasai Structural terrace and eastern part of the South Druksiai Uplift. The eastern part of the North Zarasai Structural terrace is fragmented by faults bounding the narrow (0,5–1,5 km) horsts and grabens of sub-longitudinal orientation. The faults are as long as 5–9 km, the amplitude is in the range of 10–20 m. The Apvardai–Prutas and Macionys Grabens, bounded by 3–15 km long and 10–25 m amplitude faults, are mapped in the South Druksiai Depression.

The faults striking northeast and northwest are recorded in all tectonic structures (blocks) of the new NPP area. Their length varies from 3–5 km to 15–18 km; the offset is of 15–20 m (*Marcinkevicius et al. 1995*).

7.5.1.4 Neotectonics

It can be shown using morphometric, morphostructural and the interpretation of satellite image data that most of the faults, penetrating the crystalline basement and sedimentary cover, are active neotectonically. As a rule, neotectonically active zones coincide with fault lines or are displaced near it. The faults system of the Druksiai trough, Anisimoviciu graben, and Skirnas fault are the most active. The paleoincisions are connected with neotectonically active zones. Their depth sometimes reaches 200 m (from the pre-Quaternary surface) (*Marcinkevicius et al. 1995*).

7.5.1.5 Seismic activity

Lithuanian territory is traditionally considered as non-seismic or low seismic zone. It depends on geological structure of the territory and long distance from tectonically active regions. Historical and recent instrumental data prove that seismic events of low or medium intensity have happened in territories of Baltic States (Figure 7-14).

The most recent seismic events with magnitude of 4,4 and 5,0 on the Richter scale took place in Kalingrad region of Russia in September 21, 2004. These were registered by seismological networks worldwide as well as by the seismological station of INPP.

Nineteen historical earthquakes took place within the radius of 250 km around the new NPP site between 1616 and 1965 (PNIIIS, Moscow, 1988). In the new NPP region 4 seismological observation stations were installed in 1999 (see Figure 7-14). Since then the Geological Survey of Lithuania according to agreement with INPP processes and analyses the data gathered in these stations.

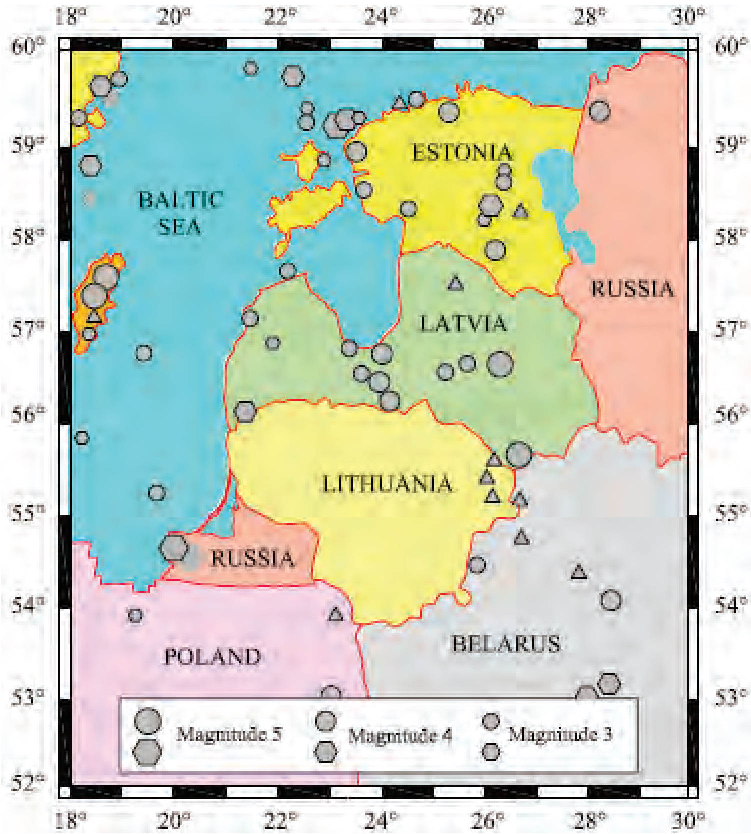


Figure 7-14. Seismicity of Baltic States: circles – historical events from 1616 to 1965; hexagons – instrumental data from 1965 to 2004; triangles – operative seismic stations.

A new VATESI regulation P-2006-01 (Requirements for Analysis of Seismic Impact, 2006) provides requirements and recommendations for the seismic design and impact analysis of the structures, systems and components of nuclear installations.

7.5.1.6 Geomorphology

From a geomorphological point of view the new NPP site is located in the Gaide glaciodepression of the Baltija Highland to the south of the lake Druksiai. The site is surrounded by hummocky moraine landscape of the marginal zone of the last (Nemunas) glaciation. The hummocky landscape of this depression is interspersed with numerous individual glacial forms such as kames, eskers, glaciofluvial hills and other ice-crevice forms (*Marcinkevicius et al., 1995*).

The new NPP area is characterized by flat transition of the waterlogged undulate plain to a marshy shore of the Lake Druksiai. The surface altitude of the shore is 1–8 meters above average annual lake water level (141,5 m) (*UAB "Hidroprojektas", 2006*).

7.5.2 Assessment of impacts on the underground

Direct impacts on the underground (geological) components and estimated indirect impacts of the changes in geological environment on other components of the environment (hydrological conditions, hydrological network, wetlands, biotopes and so on) will be presented in the EIA report.

The structural tectonic conditions in the new NPP are rather complicated. It is indicated that the vertical movements of the ground are related to the activity of the tectonic blocks bounded by the faults of the crystalline basement and sedimentary cover. The relative magnitude of the vertical movements of the blocks reaches 1.6-2 mm per year (*Report of Geological Survey of Lithuania, 2004*). Possible negative impact of the vertical tectonic movements on the construction of the new NPP will be also discussed in the EIA report.

A detailed description of the methodology for prediction and evaluation of the impacts on this environmental component due to operation of the new NPP will be presented in the EIA report.

7.5.3 Mitigation measures

Mitigation measures for the assessed impact on the underground will be described in the EIA report.

7.6 BIODIVERSITY

7.6.1 Present state of the environment

The proposed new NPP will be constructed and operated within the existing INPP industrial site. Biodiversity which should be protected at the INPP industrial site is not found.

Radionuclides in the plants

Specific activity of radionuclides in selected flora, vegetables and foodstuff due to the existing Ignalina NPP in 2006 are summarized in Table 7-14 (*INPP Report ПТОот-0545-14, 2007*). Total dose due to consumption of foodstuff containing radionuclides is 2.69 μSv.

Table 7-14. Specific activity of radionuclides in selected flora, vegetables and foodstuff in the region of Ignalina NPP in 2006.

Object	Annual consump-tion, kg	Specific activity, Bq/kg					Annual dose due to food chain (except K-40), 10^{-8} Sv
		Cs-137	Mn-54	Co-60	Sr-90	K-40	
Grass	-	0,02	0	0	1,86	749	-
Dry weed	-	<3,9	<3,9	<3,9	4,33	53	-
Milk	283	0	0	0	$1{,}14\cdot10^{-3}$	54,5	9,03
Potatoes	119	<0,2	<0,2	<0,2	-	133	-
Cabbage	10	<0,2	<0,2	<0,2	$9{,}31\cdot10^{-3}$	74,6	2,61
Moss	-	51,6	0	0	-	188	-
Mushroom	3	40,8	0	0	-	86,6	159
Venison	52	0,18	<0,2	<0,2	-	87,1	12,2
Fish	30	0,99	0	0	0,56	109	85,7

NATURA 2000 network and other protected areas

European ecological network "NATURA 2000" is a network of protected areas of the European Community, comprising of the Areas of Importance for the Protection of Birds (AIPB) and Areas of Importance for Habitat Protection (AIHP) with a purpose of conservation, maintenance and restoration (if necessary) of natural habitats and species of biological diversity within the territory of EU.

Potential „Natura 2000" territories are areas corresponding the established criteria for selection of Areas of Importance for Habitat Protection (AIHP) and indicated in the list, approved by the Ordinance of the Minister of the Lithuanian Ministry of Environment No. D1-302, dated June 15, 2005 (*State Journal, 2005, No. 105-3908*), and areas where according to the requirements stated in the Lithuanian Low on Protected Areas (*State Journal, 1993, No. 63-1188; 2001, No. 108-3902)* Article 24 Paragraph 2, protected areas are established with a purpose to grant them the status of the Areas of Importance for the Protection of Birds.

AIHP are established according to the "Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (further – Habitat Directive), and AIPB – according to the "Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds" (further – Birds Directive). Prior to establishment of AIHP (or SCI – Sites of Community Interest), based on scientific research potential AIPH are selected and the list is presented to the European Commission (EC). After the potential AIPH is approved by EC, the Member States commence their establishment. When establishing AIPB (or IBA – Important Bird Areas), first of all based on scientific criteria and research data the most suitable areas are selected. Based on these selected territories the national protected areas are established in Lithuania and later they are granted the status of protected areas of European Community interest.

Valuables of European Community interest in the areas of importance for habitat protection are indicated in the List of Territories, corresponding to the criteria for selection Areas of Importance for Habitat Protection, approved by the Ordinance of the Minister of the Lithuanian Ministry of Environment No. D1-302, dated June 15, 2005 (*State Journal, 2005, No. 105-3908*). European Commission has already approved the list of potential AIHP in Lithuania. The nearst to the new NPP "Natura 2000" network areas of importance for habitat protection are listed in Table 7-15 and presented in Figure 7-15. The details on protected species and the name and code of habitat are also indicated in Table 7-15.

Table 7-15 The nearst to the new NPP "Natura 2000" network areas of importance for habitat protection (AIPH)

The name of location	Area, ha	Comments on AIPH boundaries	AIPH code in "Natura 2000" network data base	Valuable species in the area [1]	Preliminary area of the AIPH, ha
Lake Druksiai	3611	Preliminary border is established according to the plan	LTZAR0029	European otter (*Lutra lutra*)	3611
River Smalvele and adjacent limy fens	547	The border is the same as for Smalvas hydrographical reserve	LTZAR0026	European otter (*Lutra lutra*)	

The name of location	Area, ha	Comments on AIPH boundaries	AIPH code in "Natura 2000" network data base	Valuable species in the area [1]	Preliminary area of the AIPH, ha
Lakes and wetlands Smalva and Smalvykstis	2225	The border is the same as for Smalvas landscape reserve	LTZAR0025	3140, Lakes with benthic vegetation of *Chara*	354,6
Grazute regional park	26125	The border is the same as for Gražute regional park, with the exception of the zones for recreational, agriculture and other (residential) purposes	LTZAR0024	3130, Light mineralized lakes with helofits	105
Pusnis wetland	779	The border is the same as for Pusnis telmological reserve	LTIGN0001	6230, Mat-grass swards with plenty of species	7,9

[1] – The name and code of species and habitats are indicated as they are used in the Criteria for selecting Areas of Importance for Habitat Protection, approved by the Ordinance of the Minister of the Lithuanian Ministry of Environment No. 219, dated April 20, 2001 (State Journal, 2001, No. 37-1271).

Protected territories in Lithuania with the Areas of Importance for the Protection of Birds are approved by the Resolution of Lithuanian Government No. 399, dated April 8, 2004 (amended resolution of the Lithuanian Government, dated September 25, 2006 No. 819) (*State Journal, 2006, No. 92-3635*). The nearst to the new NPP "Natura 2000" network areas of importance for the protection of birds are listed in Table 7-16 and presented in Figure 7-15. Information on what protected bird species in European interest are found in each AIPB is also indicated in Table 7-16.

Table 7-16 The nearst to the new NPP "Natura 2000" network areas of importance for the protection of birds (AIPB)

Protected area (or its part) in Lithuania	Area of importance for the protection of birds	Code in"Natura 2000" network data base	Bird species of European importance	Comments on AIPB boundaries
Part of the protected zone for Lake Druksiai	Lake Druksiai	LTZARB003	the Bittern (*Botaurus stellaris*)	AIPB takes a part of the protected territory. The border is defined according to the plan.
Parts of protected zone for Lakes Dysnai and Dysnyksciai	The complex of Dysnai and Dysnykstis lake area	LTIGNB004	Corn crake (*Crex crex*)	AIPB takes a part of the protected territory. The border is defined according to the plan.
Part of Grazutes re-gional park	North eastern part of Grazutes regional park	LTZARB004	Black-throated Diver (*Gavia arctica*), Pygmy owl (*Glaucidium passerinum*)	AIPB takes a part of the protected territory. The border is defined according to the plan.

Protected area (or its part) in Lithuania	Area of importance for the protection of birds	Code in”Natura 2000” network data base	Bird species of European importance	Comments on AIPB boundaries
Smalva hydrographic reserve	The complex of Smalva limy fens	LTZARB002	Black Tern (*Chlidonias niger*)	The border of the AIPB is the same as for Smalva hydrographic reserve

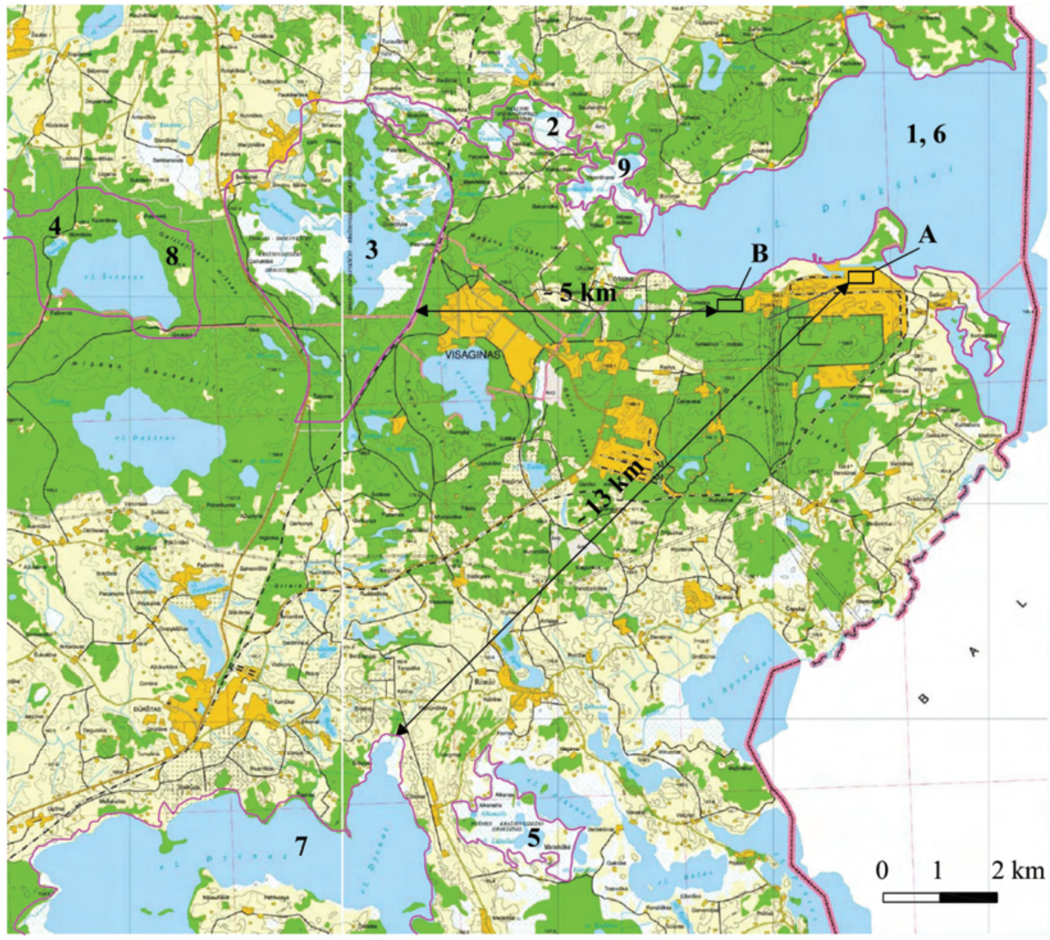


Figure 7-15 The nearst to the alternative sites A and B of the new NPP “Natura 2000” network areas (perimeters are indicated in red). Areas of Importance for Habitat Protection (AIHP): 1 – Lake Druksiai; 2 – River Smalvele and adjacent limy fens; 3 – Lakes and wetlands Smalva and Smalvykstis; 4 – Gražute regional park; 5 – Pusnis wetland. Areas of Importance for the Protection of Birds (AIPB): 6 – Lake Druksiai; 7 – the complex of Dysnai and Dysnykstis lake area; 8 – North eastern part of Grazute regional park; 9 – the complex of Smalva limy fens

The nearst to the new NPP “Natura 2000” network area is the Lake Druksiai. The territory makes about 3611 ha with a center defined by E 26 34 57 longitude and 55 37 19 latitude (W/E Greenwich).

In addition to the Bittern as a qualifying species of “Natura 2000” area, there are a lot of species of ornithological importance in the Lake Druksiai (species included in *Lithuanian Red Book* are highlighted in bold):

- As qualifying species: the **Bittern** (*Botaurus stellaris*);
- As of European importance (Birds Directive): **Black-throated Diver** (*Gavia arctica; LRB cathegory 1(E)*), Marsh Harrier (*Circus aeruginosus*), **Spotted Crake** (*Porzana porzana; LRB cathegory 3(R)*), **Little Crake** (*Porzana parva; LRB cathegory 3(R)*), **Black Tern** (*Chlidonias niger; LRB cathegory 3(R)*), **Bluethroat** (*Luscinia svecica; LRB cathegory 4(I)*);
- As of national importance: 11 breeding species: **Eurasian Hobby** (*Falko subbuteo; LRB cathegory 3(R)*), **Black Grouse** (*Tetrao tetrix; LRB cathegory 3(R)*), **Eurasian Pygmy Owl** (*Glaucidium paserinum; LRB cathegory 3(R)*), **Grey-headed Woodpecker** (*Picus canus; LRB cathegory 3(R)*), **Green Woodpecker** (*Picus viridis; LRB cathegory 3(R)*), **White-backed Woodpecker** (*Dendrocopos leucotos; LRB cathegory 3(R)*), **Citrine Wagtail** (*Motacilla citreola; LRB cathegory 3(R)*), **Great White Egret** (*Egretta alba; LRB cathegory 4(I)*), **Red-breasted Merganser** (*Mergus serrator; LRB cathegory 4(I)*), **Corn Bunting** (*Miliaria calandra; LRB cathegory 4(I)*), **Goosander** (*Mergus merganser; LRB cathegory 5(Rs)*); and also Cormorant (*Phalacrocorax carbo)*.

Protected areas are managed with the aim to preserve biodiversity in the ecosystem. Preservation of the natural environment is of the greatest importance in compare with any other activity. However, as it was mentioned, the lake Druksiai is affected by the cooling water from the Ignalina NPP. The human access is limited because of border regime.

Other protected areas are located much further from the potential sites for new NPP (e.g. lakes and wetlands Smalva and Smalvykstis – about 5 km from the site No. 2, complex of Dysnai and Dysnykstis lake area – about 13 km from the site No. 1), see Figure 7-15.

7.6.2 Assessment of impacts on vegetation, animals and protected areas

The direct and possible indirect impacts on vegetation and animal populations will be assessed. On the basis of these results, the impacts of the alternatives of the project on biological diversity and interactions will be assessed.

A special evaluation of the ecological values, potential for “Natura 2000” network aereas, will be performed (so calles “Natura evaluation”). It will be analysed if the project (individual or in context with other projects) could have significant negative influence on the ecological objects of the nearest “Natura 2000” network protected areas. Potential impact on “Natura 2000” network aeras protection and integrity due to construction and operation of the new NPP will be evaluated in the EIA report.

The possible impacts during the construction and operation phases (noise, vibration and so on) on breeding birds and other animals will be assessed in the EIA Report. Especially the impacts of cooling water for the operation phase of the new NPP on Lake Druksiai will be assessed.

7.6.3 Mitigation measures

The mitigation measures to the estimated impacts will be presented in the EIA report.

7.7 LANDSCAPE AND LAND USE

7.7.1 Present state of the environment

The proposed new NPP will be constructed and operated within the INPP industrial area. The landscape of the sites is industrial and is characterized by power production units and buildings connected to power production operation (ancillary facilities, operative spent fuel storage facility, domestic wastewater treatment plant, ducts for the urban warming system of Visaginas and the electricity transmission lines). The most visible part of the power plant is stack.

Landscape around nuclear power plant is mainly composed of forests and wetlands. Residential areas consist of small villages with traditional houses. The Lake Druksiai is a major natural landscape element with associated activities (fishing, recreational use). The valuable landscape areas (like Grazute Regional Park and Smalva hydrographic reserve) are located at about 10 kilometres from the proposed site alternatives for the new NPP (see Figure 7-15).

7.7.2 Assessment of impacts on landscape and land use

The project's impacts on landscape, present and planned land use, and the built environment will be assessed in terms of the land use plans and development of the area. The land use impacts will be assessed based on the plans prepared for the project, existing reviews and terrain visits, as well as maps and photographs from the proposed NPP area.

Landscape changes will be due to the power plant itself and the related activities. The characteristics of the environment in the vicinity of the site alternatives, as well as the sites of value in the landscape and cultural environment, will be described by means of text, maps and photographs. In the impact assessment it will be examined whether the power plant unit will change the landscape characteristics of the sites, from which direction the view towards the location will change significantly, and whether significant impacts on the possible valuable landscapes will arise. The impacts on residential and recreational areas in the vicinity of the alternative sites will be examined in particular detail.

The areas where the power plant buildings will be notably more visible than other landscape elements will be defined.

7.7.3 Mitigation measures

The mitigation measures, like measures for landscaping the changed areas by plantations, will be presented in the EIA report.

7.8 CULTURAL HERITAGE

7.8.1 Present state of the environment

The following territories are protected in the radius of 10 km from the new NPP: Smalvos protected hydrological reserve and landscape protected reserve and Tilzes geomorphological reserve (Figure 7-16). Pusnies protected territory is located about 13 km from the new NPP.

Figure 7-16. Protected territories (indicated in dark green) in the distance of 10 km around the new NPP.

There are seven cultural heritage objects in the vicinity of the new NPP: Petriskes settlement antiquities I, Petriskes mound, Petriskes settlement antiquities II, Grinkiskes settlement antiquities III, Grinkiskes settlement antiquities II, Grinkiskes settlement antiquities I and Stabatiskes manor place (Figure 7-17).

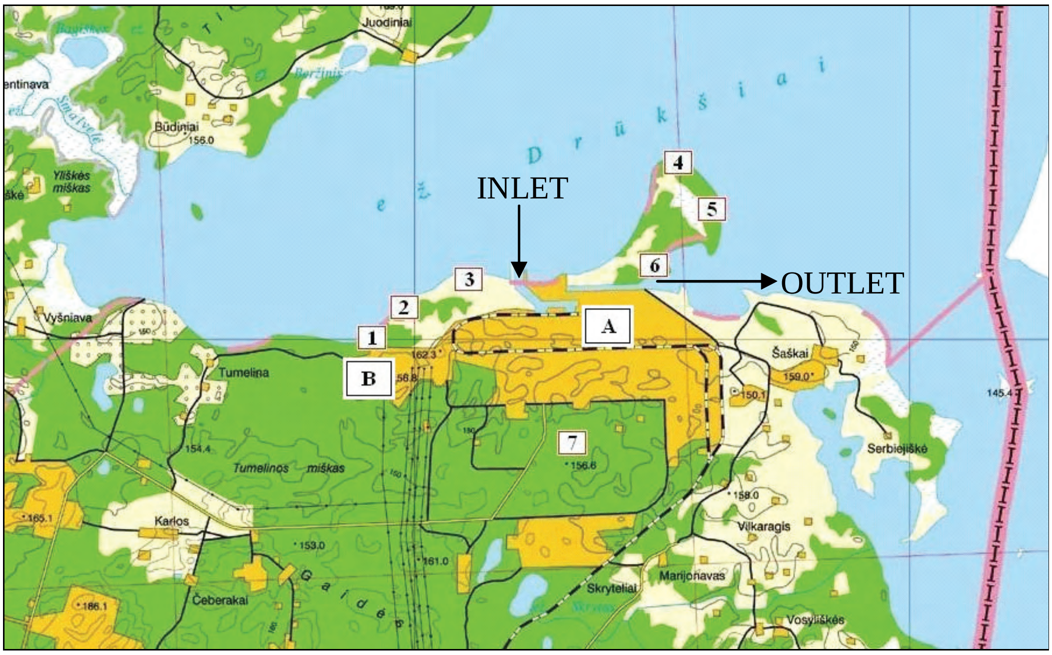


Figure 7-17. Cultural heritage objects in the vicinity of the new NPP sites A and B: 1 – Petriskes settlement antiquities I; 2- Petriskes mound; 3 – Petriskes settlement antiquities II; 4 – Grinkiskes settlement antiquities III; 5 – Grinkiskes settlement antiquities II; 6 – Grinkiskes settlement antiquities I; 7 – Stabatiskes manor place.

During the construction of INPP, the site located within the boundaries of the plant underwent large excavation works and no outstanding elements of archaeological value were found. Most likely the identified cultural heritage objects will not be affected by the new NPP construction as they are located away from the proposed sites. There are no other objects of cultural heritage, ethnic or cultural conditions that could be negatively impacted by the new NPP.

7.8.2 Assessment of impacts on cultural heritage

The project's impacts on cultural heritage will be assessed based on the current information. The location and value of cultural heritage in the vicinity of the site alternatives will be described by text and maps.

7.8.3 Mitigation measures

The mitigation measures will be presented in EIA report. The protection of the existing archaeological heritage in the vicinity of the new NPP is of primary importance.

7.9 SOCIAL-ECONOMIC ENVIRONMENT

7.9.1 General information

7.9.1.1 Population and demography

According to data for 2005 the total population of the new NPP region, which includes the municipality of Visaginas (59 km^2), Ignalina district (1 496 km^2) and the Zarasai district (1 334 km^2) was 71700 (in Visaginas 28 700 people and in Ignalina and Zarasai districts 21 400 and 21 600 people, respectively). Even IAE region comprises 4.3% of Lithuania territory, however the population number is about 2% of the total Lithuania population. Therefore, IAE region is rather sparsely neighboured place of the Lithuania. During the recent years, a decrease of population in the new NPP region is observed. From 1999 to 2005 the total population of the region has decreased by 11 500 (~14%) The information about the main demographic indicators and population distribution in the region within a radius of 30 km is presented in Table 7-17, Table 7-18 and Figure 7-18.

Inhabitants, living in the territories of Latvia and Belarus, which fall into 30 km radius zone around IAE are taken into account (Figure 7-18). Within the 30 km radius the density of population is about 48 people per km^2. This is lower than the average density of population in Lithuania (56,7 people per km^2). In fact, population density in the new NPP region is one of the lowest in Lithuania.

Within the sanitary protected area (radius = 3 km) there are neither farms nor settlements. Also economic activities are restricted (see Figure 7-19). The closest town is Visaginas, which is situated 8 km from the nuclear power plant.

Table 7-17. Demographic indicators of Ignalinos AE region in 2005.

Factor	Ignalinos dist.	Zarasų dist.	Visaginas	Ignalinos AE region
% of population < 15 years	14,58	15,81	12,70	14,36
% of population 15-44 years	34,83	36,66	48,75	40,08
% of population 45-64 years	24,62	23,92	28,74	25,76
% of population >=65 years	23,45	20,85	7,35	17,22
% of population >=75 years	10,23	9,46	1,87	7,19
Birth rate per 1000 pop.	7,45	8,49	8,16	8,03
Death rate per 1000 pop.	22,46	20,22	6,73	16,47
Natural increase per 1000 pop.	-15,04	-11,73	1,45	-8,44

Table 7-18. Population distribution (thousands) in 1999.

Radius of circle	N	NE	E	SE	S	SW	W	NW	Amount of inhabitants	
									in the ring	cumulative within the radius
30 km	38,9	0,8	8,8	1,4	1,8	2,4	2,3	0,9	57,3	135,9
25 km	1,4	1,1	2,5	2,6	4,7	1,6	1,4	8,7	24,0	78,6
20 km	0,5	0,4	1,4	1,3	1,3	2,9	0,9	0,7	9,4	54,6
15 km	0,6	0,8	1,0	0,9	0,9	1,3	0,4	1,0	6,9	45,2
10 km	0,5	0,6	0,7	0,5	1,0	0,5	34,0	0,3	38,1	38,3
5 km	-	-	-	-	0,1	-	-	0,1	0,2	0,2
3 km	-	-	-	-	-	-	-	-	-	-
Total in the segment	41,9	3,7	14,4	6,7	9,8	8,7	39	11,7	Total 135,9	

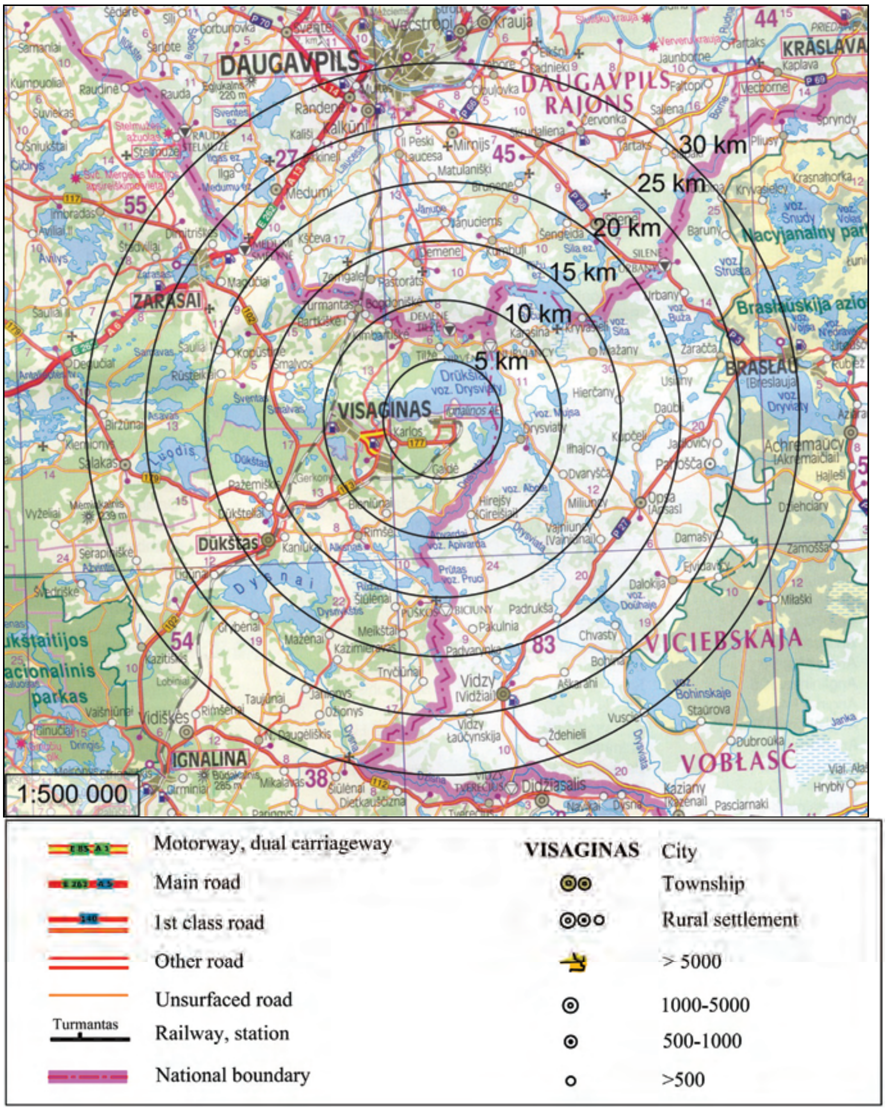


Figure 7-18. Population distribution within 5, 10, 15, 20, 25 and 30 km radiuses around the new NPP.

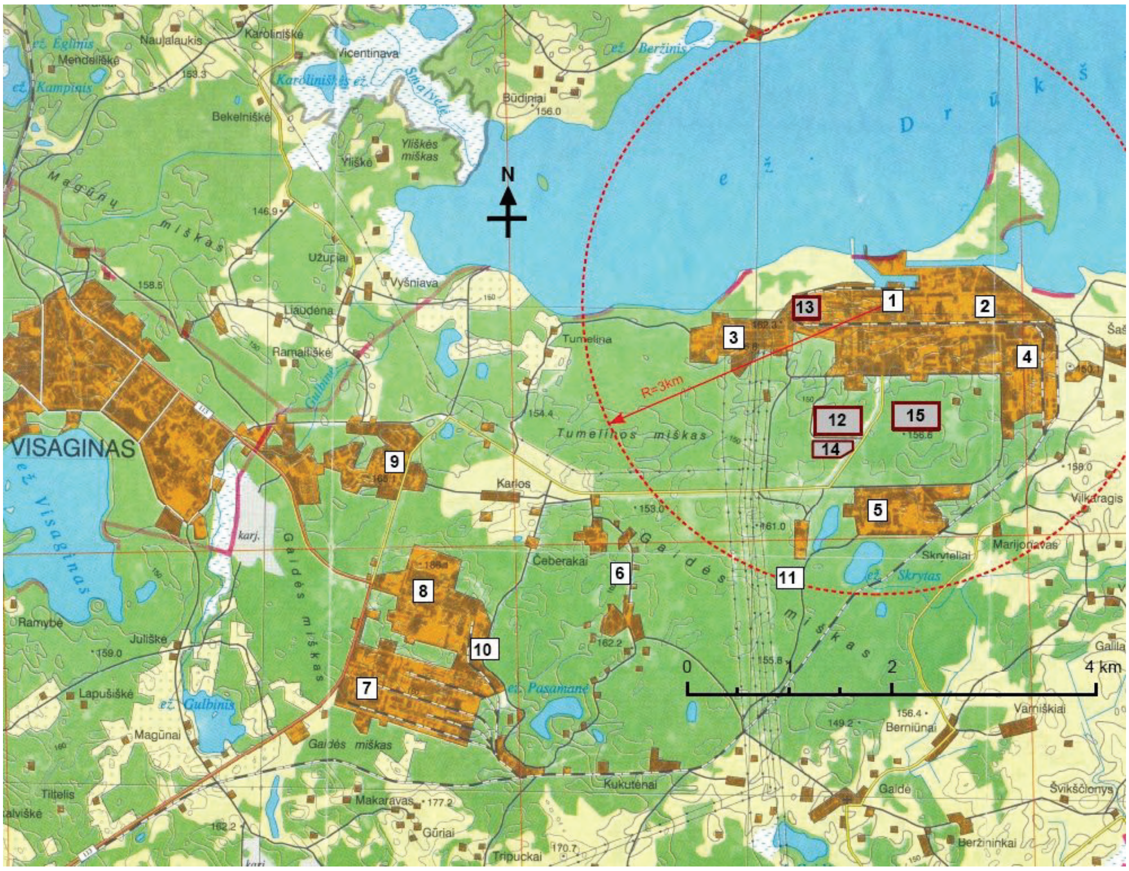


Figure 7-19. Existing SPZ of the INPP and objects in the vicinity.

(1 – Power Units, 2 – existing Spent Nuclear Fuel Storage Facility, 3 - open distributive system, 4 - supply base, 5 - sewage purification constructions, motor transport department, 6 – Visaginas waterworks (city artisan well site), 7 - construction base, 8 - industrial construction base, 9 - military base, health clinic, 10 - heat boiler station, 11 - Visaginas dump site, 12 – SWTSF and ISFSF site, 13 – SWRF site; 14 – site of the planned very low level radioactive waste near surface disposal facility, 15 – site of the planned low and intermediate level short-lived radioactive waste near surface disposal facility. The existing 3 km radius Sanitary Protected Zone of INPP is also indicated.)

7.9.1.2 Economic activities

From the economic point of view the new NPP region, except the town of Visaginas, is a less developed region in Lithuania. Agriculture and forestry of low intensity dominate in the region (for example, the intensity of cattle breeding is about 1,4 times lower than on the average in Lithuania). No important minerals (with the exception of quartz sand) are found in the region. The turnover of the retail trade in the region is 1,5, and the volume of services is more than 2,5 times lower than on the average in the country.

The town of Visaginas has an urban type labour force, which means a younger age structure (residents under 41 years of age is 67%), more educated people and greater variety of professional training. Ignalina and Zarasai districts have a rural type labour force, which means an older age structure, lower education and a small variety of professional training. The number of people in working age is 66% of population (22 200 people) in Visaginas, 52% in Ignalina district (12 900 people) and 53% in Zarasai district (13 000 people). Visaginas unemployment rate is a bit higher than average Lithuania's unemployment level.

7.9.1.3 Traffic and noise

The nearest motorway passes 12 km to the west of the new NPP location. This motorway joins the city of Ignalina with those of Zarasai, Dukstas and has an exit to the highway connecting Kaunas and St. Petersburg. The entrance of the main road from the new NPP site to the motorway is near the town of Dukstas (Figure 7-20). There is another exit to Vilnius–Zarasai motorway. The extension of the road from new NPP to Dukstas is about 20 km.

The main railroad from Vilnius to St. Petersburg passes 9 km to the west of the new NPP location (Figure 7-20).

Figure 7-20. Road and railway network.

There are 3 zones where flights are prohibited in Lithuania, the one of which is territory within 10 km around INPP. (Figure 7-21).

There are about 30 000 flights per year (in 2005) from Vilnius airport, which is located 130 km from new NPP site. About 125 000 aeroplanes per year cross the Lithuanian air space. Altogether 30 airports of civil, military and mixed purpose are located in the country.

The number of aircrafts passed the Vilnius Flight Information Region in 2000–2005 is presented in Figure 7-22.

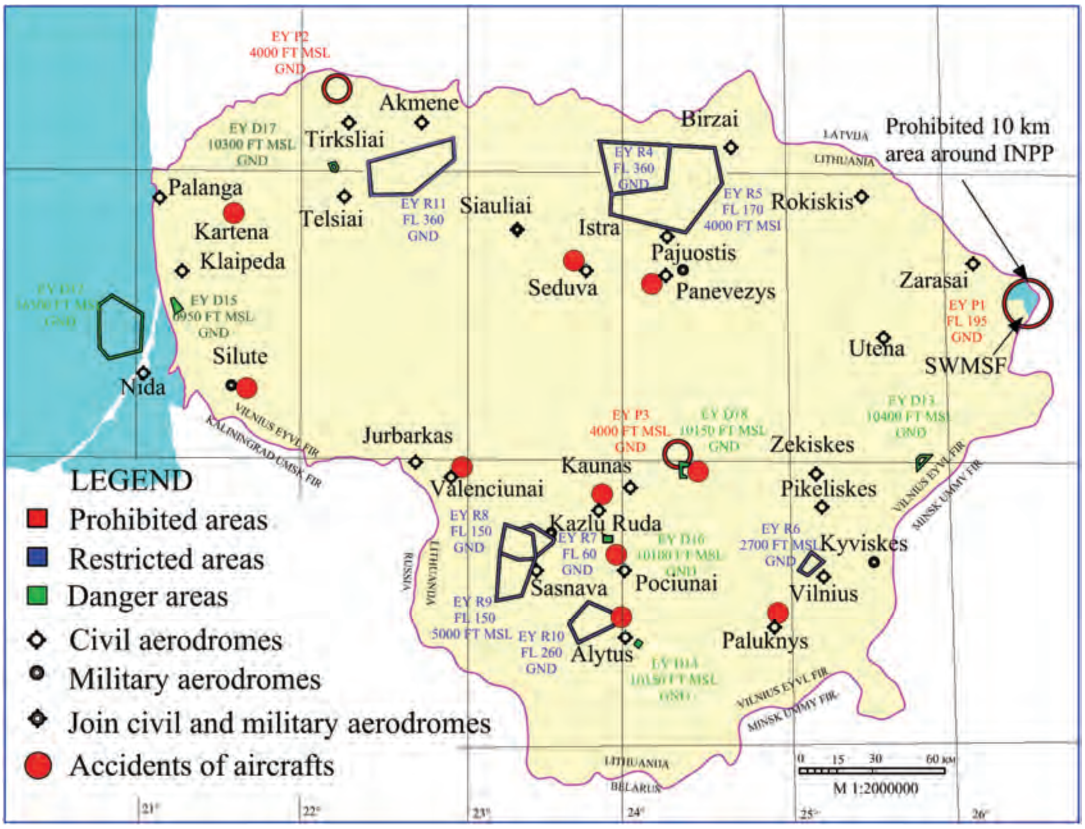


Figure 7-21. Airports, forbidden, restricted and dangerous areas in Lithuania.

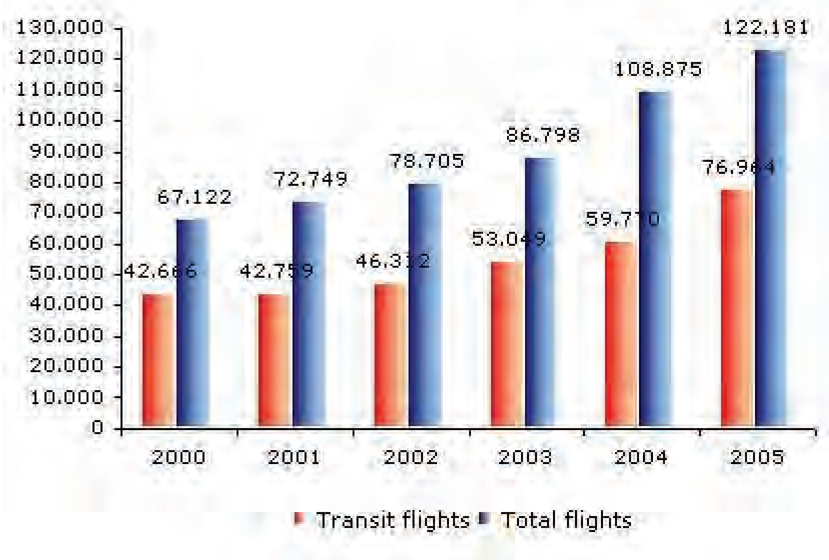


Figure 7-22. The number of aircrafts passed the Vilnius Flight Information Region in 2000–2005.

7.9.1.4 Noise and vibrations

The sources of highest noise levels at an NPP include steam ejection equipment, turbine generators, steam collectors, feeding and condenser pumps and so on. Individual work-stations with noise levels above the norms may also be found in auxiliary facilities.

7.9.2 Assessment of impacts on social-economic environment

The socio-economic impacts (impacts on employment, regional economy, demography, living conditions, etc) will be assessed in EIA Report. In this assessment the main focus will be in the new NPP region (Ignalinos dist., Zarasų dist., Visaginas), although the impacts on the regional structure and regional economy will also be examined in Utena county. This information will be presented in EIA Report in accordance to the Regulations on Preparation of Environment Impact Assessment Program and Report (*State News 2006, No. 6-225*).

The starting point for the assessment will be the present state of the area and the change imposed on it by the project. The focus areas of the assessment will be selected based on the feedback received from the residents and commuters of the area. The interaction taking place in the stakeholder group and discussion meetings, as well as the information obtained from various interest groups and the media, will serve as a tool for assessing the project's impact on people.

A resident survey will be carried out to investigate the attitudes of nearby residents towards the project and to support the assessment of social impacts. The purpose of the resident survey is to improve interaction by providing the persons in charge of the project with information about the residents' attitudes towards the project and, conversely, by providing the residents with information about the project and its impacts on their living environment. Information about the project and its environmental impacts and on the EIA procedure in general will be sent along with the resident survey.

The project's impact on recreational opportunities and living comfort will be assessed on, among other things, the basis of traffic volume changes and impacts on water systems (for example, ice conditions).

7.9.3 Mitigation measures

Measures to mitigate impacts of the proposed new NPP during construction and operation on social and economic environment will be presented in the EIA report.

7.10 PUBLIC HEALTH

7.10.1 General information

General information about population health indicators for the Ignalina NPP region (Visaginas Municipality, Ignalina and Zarasai districts) is summarized in Table 7-19.

Table 7-19. Population healt indicators for the Ignalina NPP region in 2005.

Factor	Ignalinos dist.	Zarasų dist.	Visaginas	Ignalina region
Registered morbidity per 1000 adults	1244,66	1710,17	2162,23	1705,69
Registered morbidity per 1000 children	2236,45	2826,01	3504,42	2855,63
Incidence of malignant neoplasms per 100000 pop	580,93	588,92	299,89	489,91
Prevalence of malignant neoplasms per 100000 pop.	2079,58	2097,18	1194,8	1790,52

Factor	Ignalinos dist.	Zarasų dist.	Visaginas	Ignalina region
Incidence of mental disorders per 100000 pop.	135,86	231,86	327,79	231,84
Prevalence of mental disorders per 100000 pop.	1871,15	5903,01	2333,71	3369,29
Admissions per 1000 pop.	169,78	168,42	186,53	174,91

Population health indicators for the Ignalina NPP region will be compared against the mean data values for the population in Lithuania and agaist health indicators of other regions of Lithuania in the EIA report. The present population health state also will be analysed and factors of influence on public health will be assessed.

7.10.2 Assessment of the impact on public health

The factors which potential impact the public health will be identified in the EIA Report in accordance to the Law on Assessment of the Impact on the Environment of the Planned Economic Activities (*State news 2005 No. 84-3105*). Also assessment of impact on public health will consider the requirements of Regulations for Public Health Assessment (*State News 2004, Nr. 106-3947*).

In the environmental impact assessment, the impacts of the proposed economic activity to people's health, in terms of, e.g. land use changes, radiation dose caused by radioactive releases, water system impacts, traffic impacts and safety, and noise will be investigated in EIA Report.

Evaluation of potential radiation dose to the public will be based on the data of radioactive release measurements from existing nuclear power plants and taking into consideration all significant radionuclides released from NPP into environment (airborne ant watermorne) as well as impact due to direct irradiation. The results obtained will be compared against exposure limit values and average radiation doses caused by existing NPP. Moreover, the summary of the personnel collective dose and its assessment methodology will be presented and potential impact mitigation measures will be discussed.

The Republic of Lithuania regulation HN 87:2002 (*State Journal, 2003, No. 15-624*) requires that the annual effective dose to population due to operation and decommissioning of the nuclear facility shall not exceed dose constrain of 0,2 mSv/year. If several nuclear facilities are located in the same area, the same dose constrain value shall envelope radiological impacts from all operating and planned nuclear facilities.

Potential radioactive emissions from the new NPP and other existing and planned objects in the same area will be evaluated in the EIA report. Then it will be possible to make a decision what kind of engineering and administrative means should be taken in order to meet the dose constrain set out in Lithuanian hygienic norm HN 87:2002 and normative document LAND-42.

The population health indicators, which are available and relevant for EIA will be presented in EIA report. The comparison between Utena county and Lithuania will be made. In addition to the above, the EIA report will also discuss the impacts of potential accidents.

As the closest inhabitants live about 3 km distance from the new NPP sites, preliminarily it can be assessed that there will be no adverse effect of noise on people. The noise impacts will however be assessed based on the experience gained from other similar operations, and the data and standards concerning the level of environmental noise to see if this assumption is valid.

The area, which is indicated in the existing Ignalina nuclear power plant monitoring program, will be used as a zone to evaluate impacts due to radioactive releases. According to the monitoring program, which has been coordinated with the competent authorities, monitoring of pollutants and environment (e.g. atmospheric air, soil, biota, foodstuff, potable water, etc.) under normal operation conditions is performed in this area. The greatest attention in the program is paid to the territory around the plant within radius of 15 km or less.

7.10.3 Impact mitigation measures

Measures to mitigate impacts of the proposed new NPP during construction and operation on public health will be presented in the EIA Report. Also the sanitary protection zone considering the selected new NPP site will be proposed in the EIA Report.

7.11 SUMMARY OF THE POTENTIAL IMPACT ON ENVIRONMENT DUE TO PROPOSED ECONOMIC ACTIVITY UNDER NORMAL OPERATION CONDITIONS

This chapter of the EIA report will include the summary of the assessment of radiological impacts on different components of the environment due to normal operation of the proposed economic activity, which will be evaluated in the previous sections of the Chapter 7. The impact from the other existing and planned nuclear facilities located in the Iganlina NPP sanitary protection zone will be taken into consideration as well.

Based on the evaluation presented in the sections above, in addition, potential impact to the lake Druksiai ecosystem will be summarized in the EIA report.

7.12 ACCIDENT SITUATIONS

The EIA report will discuss the environmental impacts of exceptional situations based on the safety analyses and assessments prepared for corresponding plants elsewhere as well as on the requirements imposed on the new power plant. The ramifications of exceptional situations will be assessed based on the extensive research data on the health and environmental impacts of radiation. In addition to the above, the progress of the safety of nuclear power plants will also be considered.

The safety assessments, which will be carried out for the purpose of applying for a construction and operating license, as well as other types of surveillance, will be described. The assessment report will also describe the current emergency arrangements for a nuclear accident.

7.13 DECOMMISSIONING OF THE NPP

The EIA report will present the different decommissioning phases of the new power plant, the types of decommissioning waste generated and their treatment, as well as the environmental impacts relating to them. In addition, possible land use in the plant's location after decommissioning is inspected. The decommissioning activities will also be subject to their own EIA procedures in the future.

7.14 SPENT NUCLEAR FUEL GENERATION

The different phases of spent nuclear fuel generation will be described in the EIA report on a general level.

7.15 SPENT FUEL STORAGE AND DISPOSAL

The spent fuel amount and handling will be described in EIA report. Also the potential impacts on environment and typical mitigation measures will be described on a general level, although the storing and disposal of SNF will be a subject of an own EIA procedure in the future.

7.16 COMPARISON BETWEEN ALTERNATIVES

The different impacts of the alternatives analysed (see Chapter 4) will be summarized in the EIA report as an impact matrix (table of consequences), where the main impacts on environment (positive, neutral or negative) will be compared and their viability from the environmental impact point of view will be assessed.

The information received from several different stakeholders will serve as a tool for assessing the significance of the project's impact. The assessment of the significance will also be handled in the stakeholder group that will comment on and modify the preliminary significance assessment in its meeting. The opinions of authorities, experts and the public will be recorded in the EIA report.

8 TRANSBOUNDARY IMPACTS

The impacts via Lake Druksiai to the part of the lake belonging to Belarus will be assessed. Also other potential transboundary impacts on each environmental component of neighboring country which can be expected due to proposed economical activity will be assessed.

The Ministry of Environment of Lithuania in accordance with the Espoo Convention has presented the Environmental Impact Assessment program and its summary to the respective institutions of Latvia, Estonia, Poland, Belarus, Finland, Sweden and Russia and inquired about their intention to take part in the environmental assessment procedure. The above mentioned countries have an opportunity to present their suggestions and comments on the EIA program. It should be mentioned, that all justified comments from these countries have to be taken into account while developing EIA report.

The European Atomic Energy Community (Euratom) Treaty requires that each Member State provides the Commission with plans relating to the disposal of radioactive waste (Article 37) and that the licensee declares to the Commission the technical characteristics of the installation for its control (Article 78) and submits an investment notification (Article 41).

9 MONITORING

The existing Ignalina NPP Environment Monitoring Programme includes the monitoring of all the environmental exposure pathways that may cause impacts on humans and environment. Environment Monitoring Programme is approved by competent authorities. Ignalina NPP existing Environment Monitoring Programme includes the following parts:

- monitoring of water quality in the Lake Druksiai and of groundwater (physical – chemical parameters);
- monitoring of nuclides concentration in the air and atmospheric fallouts;
- monitoring of chemical content and radioactivity of sewage and drainage water from the INPP site;
- monitoring of radionuclide release into the air;
- meteorological observations;
- monitoring of nuclides concentration in the lake and underground water;
- dose and dose rate monitoring in the buffer (3 km) and supervised (30 km) areas;
- monitoring of nuclides concentration in the fish, algae, soil, grass, sediments, mushrooms, leaves;
- monitoring of nuclides concentration in food products (milk, potatoes, cabbage, meat, grain-crops).

In accordance to Regulations on Preparation of Environment Impact Assessment Program and Report (*State Journal, 2006, No. 6-225*) the corresponding monitoring plan will be established for the new NPP. The components of the environment which are subject to monitoring will be listed in the monitoring plan and periodicity, parameters and proposed monitoring sites for each component will be indicated.

10 RISK ANALYSIS AND ASSESSMENT

Emergency situations potentially resulting from operation of the new NPP and which could lead to radiological, chemical and any other negative environmental impact will be analysed in the EIA Report with purpose to demonstrate that proposed economic activity by virtue of its nature and environmental impacts may be carried out in the chosen sites.

Potential impact on environment under different NPP conditions, i.e. under normal operational conditions, in case of design basis accidents and in general – in case of beyond design basis accidents will be analysed in the EIA report.

Emergency situations, which could lead to radioactive impact on environment, are of primary concern. Analysis of emergency situations and radioactive impact to public and environment will be based on International Nuclear Event Scale (INES), which was developed by International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency (NEA). By putting events into proper perspective, the INES eases common understanding about possible incidents and accidents at nuclear power plants. The INES does not classify industrial accidents or other events, which are not related to nuclear or radiation issues.

As there are no applicable national regulations on an accident analysis for a nuclear power plant, the classification of emergency situations will be performed following recommendations of the IAEA Safety Reports Series No. 23 “Accident Analysis for Nuclear Power Plants“, according to INES and based on existing practice.

The recommendations and requirements of the Republic of Lithuania normative documents “Recommendations for Assessment of Potential Accident Risk of Proposed Economic Activity, 2002” and “Regulations on Prevention of Industrial Accidents, their Elimination and Investigation (*State Journal, 2004, No. 130-4649*) will also be taken into consideration.

Potential hazards will be identified, their occurrence will be assessed and risk of emergencies will be analysed and evaluated in EIA report. Internal and external events potentially leading to incidents or accidents will be considered. Hazard risk mitigation and accident prevention measures will be discussed in EIA report.

11 ANTICIPATED DIFFICULTIES DURING EIA PREPARATION

Description of difficulties (technical or practical) encountered by the EIA developers while preparing the environmental impact assessment will be presented. No difficulties are presently expected.

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