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Pöyry Energy Oy
Lithuanian Energy Institute

Environmental Impact Assessment Report
New Nuclear Power Plant in Lithuania
August 27th 2008

Organizer of proposed economic activity: **Lietuvos Energija AB**

Developer of EIA report: **Pöyry Energy Oy (Finland)**
Lithuanian Energy Institute (Lithuania)

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BI – Institute of Botany;
FI – Institute of Physics;
GGI – Institute of Geology & Geography;
LEI – Lithuanian Energy Institute;
NVSPL –The National Laboratory of the Public Health Care;
VPI - Vilnius Pedagogical University.

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GLOSSARY

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}.
Aerosol	Small floating particle
AGIR	Advisory Group on Ionising Radiation
ALARA	As Low As Reasonable Achievable. This is an internationally recognized acronym which requires that the radiation dose to personnel which results from work with radioactive substances is minimized to the greatest possible extent, except where the additional cost or impracticality of further dose-reduction measures would be unreasonable when compared to the additional dose-reduction obtained by the adoption of those measures. The ALARA principle is progressively used in environmental issues as well.
Alpha/ beta/ gamma emitters	Nuclei that emit alpha, beta or gamma type of ionizing radiation
AOO	Anticipated Operational Occurrence
Aquifer	An aquifer is an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which groundwater can be usefully extracted using a water well.
ASKRO	Part of a permanent real-time environmental and sanitary control system. The purpose of the system is to inform the population on radiation security.
Background contamination	Levels of hazardous substances in the environment that are either naturally occurring, from an off-site source or a result of general contamination in the area.
bar	A unit of pressure. 1 bar = 100 000 pascal (Pa). Atmospheric pressure is approximately 1 bar.
BDBA	Beyond Design Basis Accident
Bq, Becquerel	The SI unit of activity, equal to one transformation per second.
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.
Cloud shine	Exposure to gamma radiation from radioactive materials in an airborne plume
Collective dose	Product of the number of persons of the exposed population group and the average dose per person; unit mansievert [manSv]
Condenser	Condenser converts and recovers the steam that passes through the turbine from its gaseous to its liquid state
Cooling water	Cooling water is sea/lake/river water used in a condenser for cooling the steam coming from the turbines back to water. Cooling water does not come into contact or mix with the process waters of the nuclear power plant.
D&D	Decontamination & Decomissioning
DBA	Design Basis Accident
DCD	Design control documentation
Deuterium	Isotope of hydrogen which nucleus contains one proton and one neutron
Direct cooling system (DC)	Cooling water is taken from water reserve (e.g. lake), led through a heat exchanger and the warmed water is discharged back to the reserve.
E.ON	E.ON AG; Germany based energy corporation
EDF	Electricité de France
Effective dose	Includes both external (cloud shine and ground shine) and internal (inhalation and ingestion) dose

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
EnBW	Energie Baden-Württemberg AG
Enrichment	Concentration of a substance. Before enrichment, uranium is converted in gaseous form through chemical processes to uranium hexafluoride (UF_6). The enrichment of uranium hexafluoride is executed either by gas diffusion or nowadays increasingly by centrifuge methods by utilizing chemical and physical characteristic of the uranium.
Environmental Management System (EMS)	EMS serves as a tool to improve environmental performance. Defined in ISO 14001 standard. Provides a systematic way of managing an organization's environmental affairs and is the aspect of the organization's overall management structure that addresses immediate and long-term impacts of its products, services and processes on the environment.
Equivalent dose	The absorbed dose adjusted for the relative biological effect of the type of radiation being measured
EUR (European Utilities Requirements document)	the European Utility Requirements (EUR) document aim at harmonisation and stabilisation of the conditions in which the standardised LWR nuclear power plants to be built in Europe.
Eutrophication	Eutrophication is an increase in nutrients in an ecosystem.
External exposure	The dose that Includes the dose from cloud shine and the dose from ground shine
FCS	Favourable conservation status
Fission	The splitting of a heavy atomic nucleus into two parts, accompanied by the release of fast neutrons.
FMI	Finnish Meteorological Institute
Fujita classification	A scale for rating tornado intensity, based on the damage tornadoes inflict on human-built structures and vegetation. Scale: F0-F12. F0 corresponds to wind speed of 64-116 km/h. F12 is equal to 1 Mach.
Gaseous radioactive emissions	Radioactive material particles released from the source to atmosphere.
GE	General Electric Company
Ground shine	Exposure to gamma radiation from radioactive materials deposited on ground
Half-life	The time it takes for the amount of radioactive matter to be reduced to half as a result of radioactive decay, i.e. as half the matter is converted into another type of matter.
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.
HVAC	Heating, Ventilating and Air Conditioning
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.
INPP	Ignalina nuclear power plant

Integrated Monitoring (IM)	Simultaneous measurement of physical, chemical and biological properties of an ecosystem over time and across compartments at the same location.
Internal exposure	The dose due to inhalation or ingestion of radioactive material
InterRAS	A computer software for assessing the implications of nuclear accidents used in the first phase of an emergency
Ionising radiation	Radiation capable of producing ion pairs with differing charges in the biological environment.
ISO 14001 standard	An international voluntary standard describing specific requirements for an EMS(Enviromental management system). ISO 14001 is a specification standard to which an organization may receive certification or registration. Published by International Organization of Standardization.
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.
Isotope-specific analysis	Analysis of masses by mass spectrometry and neutron activation analysis and analysis of radiation from the atom, as is done by α-, β-, γ– and sometimes X-Ray spectrometry.
Light water	Regular water, H_2O
LOCA	Loss Of Coolant Accident
LRDB	Lithuanian Red Data Book serves as a legal document on which the protection of rare and endangered plant, fungi and animal is based.
LULUCF (Land use, land use change and forestry)	Tree-planting projects, reforestation and afforestation, designed to remove carbon from the atmosphere
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.
Mansievert (manSv)	A unit of collective dose. If, for example, each person in a population of 1000 members receives an average radiation dose of 20 millisieverts, the collective dose is 1000 x 0,02 Sv = 20 manSv
Monitoring zone	An area in which monitoring is performed.
MOX fuel	Mixed oxide fuel. Blend of oxides of plutonium and natural uranium, reprocessed uranium, or depleted uranium.
MW, megawatt	A unit of power (1 MW = 1 000 kW).
MWd(th)/TeU	The energy produced per initial unit of nuclear fuel weight.
NNPP	New nuclear power plant
NRDB	Natural Resources Data Base
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.
Nuclear Power Plant (NPP)	A complex of equipment and buildings intended for generating electricity or electricity and heat by using nuclear fuel.
N/A	Not applicable
OKB	*Опытное конструкторское бюро*: Development Design Bureau
Precipitation	Any product of the condensation of atmospheric water vapor that is deposited on the earth's surface

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)
Radiation	
Alpha	Alpha radiation is of positively-charged particles emitted from the nucleus of an atom. Alpha particles are helium nuclei, with 2 protons and 2 neutrouns
Beta	Particle radiation consisting of electrons or positrons
Gamma	Gamma radiation is radiation travelling as electromagnetic waves whose wavelength is smaller and energy higher than those of X-rays
Radioactive emissions	Radioactive pollutant in gaseous form, as aerosols, liquids or in other form released into environment.
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).
Radionuclides	An unstable form of a nuclide
RADIS	Automatic Measurement Systems Division. Maintains the automatic gamma-monitoring network and the mobile radiological laboratory.
RBMK	*Reaktor bolshoy moshchnosti kanalniy* is a Russian water-cooled graphite-moderated channel-type reactor type used in INPP
Reactor types	
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.
ACR	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.
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.
HWR	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.
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.
EPR	European Pressurized Reactor.
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.
RWE	RWE AG; Germany based energy corporation
SA	Severe Accident
SAC	Special Area of Conversation
SPZ	Sanitary Protection Zone: A special territory or a site of radioactive contamination where the irradiation level may exceed the prescribed norms under normal operational conditions of a nuclear facility.
SAR	Safety Analysis Report
SCI	Sites of Community Importance
SILAM	Air Quality and Emergency Modelling System SILAM of the Finnish Meteorological Institute
SPA	Special Protection Area
Specific activity	Ratio of the sample's activity and its mass (unit – Bq/kg)
SNF	Spent Nuclear Fuel: 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
TLD stations	Thermoluminescent Dosimeter (TLD) stations are used to measure external radiation exposure rates in the site.
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.
UK HSE	United Kingdom Health and Safety Executive
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.
UO_2	Uranium dioxide
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.
US NRC	United States Nuclear Regulatory Commission
VATESI	Autonomous Lithuanian State Nuclear Power Safety Inspectorate
Waterborne releases	Radioactive effluents, released to environment.
WWTP	Waste water treatment plant
Yellowcake	Uranium concentrate; U_3O_8 (triuranium oxide)
Zircaloy	Group of high-zirconium alloys. Mainly used as cladding of fuel rods

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EXECUTIVE SUMMARY

During spring of year 2007, Lietuvos Energija AB started an Environmental Impact Assessment (EIA) procedure for the construction of a new nuclear power plant (NNPP) to be located next to the present Ignalina nuclear power plant (INPP). The EIA is a prerequisite for the construction of such an important installation. It has to describe how the plant will influence the surrounding environment and evaluate if the impacts of the project are environmentally and socially sustainable. Only after the EIA has been exposed to the local and international communities and is approved by the Lithuanian Ministry of Environment can the project proceed. Based on Lithuanian regulations, the EIA procedure first involves preparation of an EIA Program (EIAP), which has to give the structure of the EIA and a description of the topics that will be studied and the methods to be employed. Based on the EIA Program, terms set by the Ministry of Environment, and received comments, an EIA Report (EIAR) is prepared, which describes the environment and assesses the environmental and social impacts of the project. The EIA Program was published July 26th, 2007, and it was approved by the Lithuanian Ministry of Environment on November 15th, 2007 after extensive national and international commenting. EIA Report has been prepared by an international consortium consisting of Pöyry Energy Oy and the Lithuanian Energy Institute (LEI) as commissioned by Lietuvos Energija AB. Preparation of the EIA Report began in February 2008 and the EIA Report was published and put on display for commenting on August 27th 2008.

THE PURPOSE, LOCATION AND SCHEDULE OF THE PROJECT

The project assessed in this EIA Report is the construction of a new nuclear power plant (NNPP) in the near vicinity of the present Ignalina nuclear power plant (INPP), in the municipality of Visaginas on the shore of Lake Druksiai in north-eastern Lithuania. The INPP is the main electricity source for Lithuania at the moment, but, as a condition of entry in the European Union, the Lithuanian government has agreed on shutting down the INPP since it does not meet the required safety standard conditions. The first unit of INPP was shut down in 2004, the second is still in operation and is to be shut down by the end of 2009. In order to face this electricity gap, the Lithuanian government started the decisional process for the construction of a new and safer regional NPP, capable of supplying also part of the neighbouring countries' needs for electricity.

The scheduled construction time for the new NPP is around 8-9 years from the start of the EIA procedure. This would mean 2015 as the earliest year for commissioning of the NNPP, which would match the forecasts of the Lithuanian National Energy Strategy.

PROJECT OPTIONS AND LIMITATIONS

There are two potential sites for the construction of the new NPP, both located on the shore of Lake Druksiai: Site No. 1 is situated east of Ignalina NPP and Site No. 2 is situated west of the existing INPP switchyard.

The choice of technology to be adopted in the new NPP is still open. All the suitable main reactor technologies (Boiling Water Reactor, Pressurized Water Reactor and Pressurized Heavy Water Reactor) have been evaluated in this EIA Report, considering different vendors, different power levels, the two site alternatives for the construction of the plant and different cooling alternatives. The maximum power output of the NNPP discussed in this EIA Report is 3 400 MW, with the number of reactors varying from 1 to 5 depending on the technological alternatives and total power generation capacity to be constructed. Different cooling system options have also been studied and the cooling capacity of and impacts on Lake Druksiai has been assessed.

LINKS TO OTHER PROJECTS AND PLANS

The new NPP will be erected next to Ignalina NPP, but will be operated by a different company. The location next to INPP provides the opportunity to utilise existing infrastructure, whenever this is feasible. This existing infrastructure that can possibly be utilised includes among others the cooling water inlet and outlet channels, electric systems and transmission lines, and monitoring systems. New facilities for storage of radioactive waste and spent nuclear fuel are under study and planning, and will be further studied and assessed in other EIA's.

The INPP provides district heating to the town of Visaginas. New gas fired boilers have been constructed to provide heat to the city after the shutting down of INPP. Producing heat for district heating in Visaginas is an option under consideration in the NNPP project.

Decommissioning of INPP will continue for decades, and will thus be ongoing during construction and operation of the NNPP. New radioactive waste handling and storage facilities will be constructed as part of the decommissioning project. The aggregated impacts of these projects have been assessed in this EIA.

The Visaginas municipal waste water treatment plant (WWTP), which INPP utilizes and which the NNPP will utilise, is to be modernised in a project which has started in 2008. After this the capacity and treatment efficiency will be sufficient for the NNPP.

IMPACTS DURING THE CONSTRUCTION PHASE

The construction of the power plant will require a vast amount of workers in the area. It is estimated that up to 3 500 workers will be needed for the construction, while around 500 employees will be needed during the operational phase, depending on the technology chosen and the operation procedures. Foreign work force will be required during the construction phase.

The new labour force needed for the construction of the power plant will affect the economics and demography of the region. The NNPP region in Lithuania and Latvia will for 5-7 years have to host an exceptional amount of people. This will lead to a significant demand for goods and services and very significant positive socioeconomic impacts.

The construction works have to be accurately organized, since they will involve a large amount of labour force in the vicinity of the decommissioning project of INPP. Attention will have to be paid to the problems that the vicinity of these activities can create to each other in terms of traffic and congestions.

The first step of the works will involve excavation works, with the removal of up to 1.4 million cubic meters of excavated and blasted materials. Disposal areas will be required for this amount of soil. The construction works will increase the amount of traffic (especially cars and trucks) on the roads connecting Visaginas with the power plant construction site. It is estimated that 1 800 cars, 100 trucks and 60 buses will drive back and forth every day, producing emissions and noise. The traffic will however not have long term impacts on the air quality. Dust will also be generated, but will only affect the area of the construction site.

The waters of Lake Druksiai as well as groundwater will not be significantly affected by the construction of the NNPP because of implementation of an appropriate waste water system. Any direct discharge of untreated and polluting or hazardous material in the lake's waters will be strictly forbidden.

A significant amount of ordinary waste will be generated in this phase, including recyclable waste, waste suitable for energy production and hazardous waste. The shares and proportions will depend on the ability of the project implementation company to minimize the waste amounts and maximise recycling of the waste.

The noise level during the construction years would increase, but the construction site is located in an uninhabited area.

There will be no radioactive releases during the construction phase.

OPERATIONAL PHASE IMPACTS

The state of waters

The new NPP will use water from Lake Druksiai for heat dissipation. The cooling water will be warmed up approximately ten degrees when passing trough the nuclear power plant in the case of direct heating, where the heated cooling water is discharged back to the lake. The quality of the cooling water will not change in any other way. Model computations of the impact of releases of warm cooling water to Lake Druksiai were carried out with a three dimensional hydrodynamic model. The effects of different NNPP thermal loads to the lake and different NNPP cooling water inlet and outlet locations on the water temperature of Lake Druksiai were investigated.

Based on modelling results and expert assessments it can be concluded that the ecologically acceptable thermal load to the lake will be approximately 3 200 $MW_{released}$, With this thermal load no significant impacts on the lake ecosystem are expected compared to the present state of the lake. With higher thermal load the impacts on the lake ecosystem start to be clear and significant.

The current outlet is the best alternative when the area warmed up is used as criteria. However, the different outlet options do not significantly differ from each other. The present NPP outlet position allows the cooling water to spread efficiently to the main part of the lake, allowing both cooling by heat exchange to atmosphere and mixing to cooler lake water.

The main hydrological impacts of the operation of the new NPP are the evaporative losses created when the heated cooling water will transfer the heat load to air by evaporation. According to water balance calculations the water resources will be adequate for the operation of the NNPP also during dry years.

During normal hydrological years the average lake level is not expected to fall below the normal and thus the hydrological effects on the lake and their ecological consequences are considered minor. During dry years the lake level would fall below normal, however staying above the minimum allowed regulation level (for approximately three successive dry years). Thus also the consequences of this kind of rare event can be estimated to be small.

All the waste waters from the new NPP will be treated according to regulations. The nutrient and other load from the NNPP will be small compared to the total load to Lake Druksiai coming from other sources.

Climate and air quality

The operation of the new NPP will cause very limited emissions, mainly from the back up diesel engines and the traffic. These emissions will not have a significant detrimental impact on the ambient air quality of the Visaginas region, also taking the background contamination into account.

Geology, soil and groundwater

No significant impacts on geological conditions, soil or groundwater are expected during operation of the NNPP in either site alternative.

Biodiversity

Lake Druksiai and several other areas in the region are included in a European Union network of protected areas named "Natura 2000" and certain values of these areas are therefore to be preserved under specific regulations of the EU. The main focus of biodiversity impact assessment has been on the Lake Druksiai Natura 2000 –area. Lake Druksiai has been included in the Natura 2000 network based on both the EU Birds Directive and the Habitat Directive. The main focus has been on the possible water temperature change in the lake due to cooling water discharge, and the potential impacts of this on biodiversity values. Lake Druksiai can for ecological reasons not tolerate the planned maximum power generation. A maximum thermal load of approximately 3 200 $MW_{released}$ can be discharged to the lake without significant adverse impacts on essential biodiversity values of the lake, including the designation values for Lake Druksiai Natura 2000 area, being anticipated. Mitigation measures for biodiversity impacts are required.

Noise and the presence of workers, as well as direct construction measures destroying habitats will cause adverse impacts on other biodiversity values as well in both site alternatives. These impacts can however be mitigated to an acceptable level.

Landscape, land use and cultural heritage

The assessment of the landscape of the area shows how it already has been damaged by the construction and operation of the present power plant. The NNPP project would not cause further particular damages to the landscape. Photomontages showing possible impacts on the landscape from the most significant viewing points have been prepared and are provided in the EIA report.

No impact on cultural heritage values is expected in either site alternative.

Socio-economic environment

A significant positive impact on the socioeconomic environment of the NNPP region is expected. The new activity would reduce the adverse effects of the closure of the INPP, which would let the region without its main employment source. A need for a large workforce, in the order of up to 3 000–3 500 workers, will occur during the construction phase. This workforce will to a significant extent utilize the services of the region in both Lithuania and Latvia, which will bring significant positive socioeconomic impacts to the region. About 500 employees would work permanently in the NNPP.

A resident survey was performed in the area of the town of Visaginas and its surroundings as part of the EIA. The results show how the attitude of the great majority of inhabitants is favourable to the NNPP project.

Public health

The NNPP and the related traffic can have an adverse impact on air quality but the impact is so minor that it will not affect public health. The levels of noise in the vicinity of the NNPP will stay below allowable limits. The main positive impacts of the NNPP on public health are through the areas of improved economy and social security.

There will be no radiological impact on the population during the operation of the NNPP. The annual dose of the critical group members of the population due to releases of radioactive effluents (both airborne and liquid) vary in the range from 3.4 to 43.4 μSv depending on the reactor type, capacity and total number of units. This is well below the dose constraint established for the protection of the health of members of the public, which is 200 μSv per year.

Based on experience from other countries and estimations about the impact of the NNPP on the public, the sanitary protection zone for the NNPP is suggested to be of 1 – 3 kilometre radius depending on the reactor type chosen. The proposed sites for the NNPP are within the existing INPP industrial site and sanitary protection zone. The shortest distance from the proposed sites to the boundary of the existing sanitary protection zone is about 1.5 km.

IMPACTS OF NUCLEAR FUEL PRODUCTION AND TRANSPORTATION

Fuel for the new power plant will be uranium dioxide and it will be procured from the international nuclear fuel market. The uranium market would operate regardless the implementation of the NNPP.

Uranium mining, processing and transportation are performed following national and international regulations and agreements, prepared in order to minimize the damages to the environment and the exposure of the workers to radioactivity.

Nuclear fuel would be transported to the NNPP either by train or by truck.

WASTE

Radioactive waste is the main by-product of a nuclear power plant, and the amounts can differ significantly with the different available technologies. Spent nuclear fuel is initially cooled down in pools contained in the power plant unit to decrease its radioactivity. Afterwards it has to be disposed of and for this purpose there are different options available. The capacity of the INPP spent nuclear fuel storage facility is almost spent and the facility would not be able to store spent nuclear fuel or radioactive material from the new NPP. The importance of the topic makes further studies and EIA's focused on this necessary, in order to find the best solution, considering the regional, national and international conditions.

The NNPP produces solid, liquid and gaseous radioactive waste, which have been studied in the EIA Report considering the different technological options. The operation of the NPP will cause no harmful radioactive releases or any radioactive contamination because of the waste produced. The amounts will be lower than the limits set by the national and international legislation and the surrounding environment will not be significantly affected.

The NNPP will also produce conventional and hazardous waste. The NNPP operators will establish internal operations to enhance recycling and set agreements with licensed waste management companies, able to dispose this waste amounts safely without any harm for the environment.

MONITORING SYSTEMS

Environmental legislation requires parties responsible for projects and operations affecting the environment to carry out environmental monitoring. The Ministry of Environment of the Republic of Lithuania controls implementation of environmental monitoring, quality of monitoring data and information, and compliance with the standards and other normative legislation. The monitoring system for the new NPP will be designed to fulfil all the requirements of the Lithuanian legislation and regulations, the IAEA recommendations and obligations under the United Nations Conventions. The existing INPP monitoring system will be utilized where applicable. All the monitoring systems and devices applied will however be modernized to meet the current requirements on preciseness and periodicity. The monitoring sites and objects will be kept unaltered when possible to assure the comparability of the existing INPP monitoring data with the new system.

TRANSBOUNDARY IMPACTS

The transboundary impacts are mainly socioeconomic or linked to the impacts on Lake Druksiai. Radiological transboundary impacts will not occur during normal operation of the NNPP.

A significant positive impact on the socioeconomic environment in the foreign parts of the NNPP region is expected, mainly in Latvia through the need for workforce, accommodation and services. No significant negative socioeconomic impacts are expected as the NNPP will be constructed next to an existing NPP, to which the surrounding areas have adjusted.

Evaporation of water by cooling the NNPP would reduce the overall volume of water in Lake Druksiai, thereby impacting the quantity of water discharged to River Prorva. The decrease of mean flow would impact the approximately 50 km long stretch of River Prorva before the confluence of River Dysna. The minimum allowable discharge in River Prorva will remain at the present level (0.64 m^3/s) in all of the cooling scenarios.

No significant transboundary impacts on terrestrial and semi-aquatic fauna, flora and biodiversity are expected.

NUCLEAR SAFETY AND RISK ANALYSIS

High safety culture and special safety principles and regulations are required in the design and operation of nuclear power plants. The fundamental safety objective is to protect people and the environment from harmful effects of ionizing radiation. All the most relevant principles of nuclear safety are clearly presented in the EIA Report, together with all the well-established procedures able to minimize any risk of accident. The use of nuclear power in Lithuania requires a license and it is regulated by law. The authorities involved in the safety of the nuclear installations in Lithuania are the State Nuclear Power Safety Inspectorate (VATESI), the Ministry of Health (via the Radiation Protection Centre), the Ministry of the Economy, the Ministry of Environment and the Ministry of Internal Affairs.

A risk analysis of potential accidents resulting from the proposed economic activity has been done according to the recommendations of normative document "Recommendations for Assessment of Potential Accident Risk of Proposed Economic Activity" as part of the EIA. Accidental releases from the NNPP and their impacts on the environment and public have been considered for two scenarios: design basis accident (DBA) and severe accident. Loss-of-coolant accident has been chosen as the DBA to be assessed since it envelopes the consequences of all DBA's. For the severe accident case the source term for release into the environment has been estimated based on a 100 TBq release of Cs-137.

The dispersion of accidental releases in these situations has been simulated with Air Quality and Emergency Modelling System SILAM of the Finnish Meteorological Institute (FMI). The approach applied is based on brute-force multi-scale computations of dispersion using actual meteorological data from weather archives. To cover all realistic meteorological conditions several cases in different meteorological conditions during the years 2001 and 2002 have been simulated.

The assessment of doses received by the public as a result of accidental releases is based on the results of the dispersion simulations and it utilizes empirical coefficients and methodologies for converting the modelled concentrations in air and depositions to doses. The exposure of the environment and people depends on the specific meteorological conditions during the accident and the geographical location of the receiving point and thus the results of the study are given as 2-dimensional maps of the exposure levels, which are not exceeded with a certain probability for any realistic meteorological conditions.

The results of the dispersion modelling and dose estimation have showed that the dose for the members of public caused by the Loss-of-coolant accident is less than 10 mSv as required by the Lithuanian Regulation. Sheltering is not necessary in Lithuania or abroad in case of both Loss-of-Coolant accident or a Severe accident, neither is evacuation, temporary relocation or permanent resettlement. The main protective actions in case of a Severe accident are iodine prophylaxis and restrictions on the use of foodstuffs, milk and drinking water. Some mostly short time restrictions of certain foodstuff will be needed in case of both severe accident and Loss-of-coolant accident.

To mitigate the consequences of an accident to the public, the power plant and rescue service authorities maintain emergency preparedness. The Lithuanian nuclear energy legislation sets requirements for civil defence, rescue and emergency response actions.

IMPACTS OF DECOMMISSIONING

The decommissioning phase is a long and expensive process that will generate both ordinary and radioactive waste. A relevant amount of resources and time can be saved designing a reactor with the coming decommissioning project in mind. Moreover, the fact that this phase will not occur before the end of the life cycle of the plant (around 60 years of operation) gives time to the power plant operators to gather the resources needed for the implementation of this phase.

Decommissioning of the NNPP will undergo appropriate environmental impact assessment in due time.

INTERACTION

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.

The competent authority, the Lithuanian Ministry of Environment, is responsible for the coordination of the EIA procedure.

Different stakeholder groups were consulted when needed during the preparation of the EIA Report and the supporting reviews.

The EIA Report will be available for public display. The motivated (justified) proposals, that will be received, will be registered, evaluated and attached as appendixes to the approved EIA Report. Public information and discussion events will be organized in the countries concerned.

The review of the EIA Report by relevant parties, including governmental institutions, responsible for health protection, fire-prevention, protection of cultural assets, development of economy and agriculture, and municipal administrations, has an important role in ensuring the quality of the EIA procedure.

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 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 authorities of Latvia, Estonia, Poland, Belarus, Finland, Sweden and Russia about the commenced environmental assessment process of the new nuclear power plant in Lithuania and inquired about their intent to take part in the environmental assessment procedure. Austria, Belarus, Estonia, Finland, Latvia and Sweden gave their comments on the environmental impact assessment of the new NPP. The comments have been taken into account in the preparation of the EIA Report and the supporting reviews.

Information about the EIA procedure is provided at Lietuvos Energija AB's website - http://www.le.lt and the new NPP project website http://www.vae.lt. The websites provide up-to-date information on the progress of the EIA procedure. The EIA Program and EIA Report are available in the Lithuanian, English and Russian languages on the website.

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 (INPP). The net electrical output of new nuclear power plant (NNPP) would be at most 3 400 MW and it would replace the current INPP Unit 1, which was closed on December 31, 2004 and Unit 2, which is scheduled to be shut down at the end of 2009.

Lithuania has no primary energy sources of its own. From the late 1980s, the Ignalina nuclear power plant (INPP) has produced a large percentage of Lithuania's electricity. The Lithuanian electricity and gas networks are closely interrelated to the north-west power sectors of the Russian Federation.

The meeting of the finance ministers from the group of seven industrialized nations of the world in Munich in 1992 was crucial to Lithuania and operation at INPP. The political decision was made that its RBMK reactors should be closed, as the reactors were judged incapable of being upgraded to western safety levels.

Presently the 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 NPP would meet the aims of the National Energy Strategy (*State Journal, 2007, No. 11-430*). 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 Republic of Lithuania Law on Environmental Impact Assessment of the Proposed Economic Activity (*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 (EIA) procedure must be carried out. The objectives of the EIA are defined in the Article 4 of the named law 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 content and structure of this EIA Report meet the requirements of the Republic of Lithuania Law on Environmental Impact Assessment of the Proposed Economic Activity (*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 the proposed economic activity is Lietuvos Energija AB.

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1.2 DEVELOPERS OF THE EIA REPORT

The developer of the EIA Report 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**
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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 capacity of electricity production of the new NPP will not exceed 3 400 MW.

The new nuclear power plant will consist of one to five units. In some parts of this assessment the impacts are assessed for one or two reactors of about the size of 1600-1700 MW. In these cases the impacts of three to five units with smaller reactor size are assumed to be the same as for the two units with greater reactor size.

In the new NPP, electricity will be generated in accordance with the principles and regulations concerning the internal energy market of the European Union (EU). In accordance with sustainable development, the EU aims to reduce harmful environmental impacts of energy production and use. Another objective is to increase the EU’s competitiveness, which requires investments in the energy production and transmission capacity. It is estimated that investments of EUR 900 billion in new electricity generation capacity will be needed in the EU area during the next 20 years. To secure the reliability of energy supply, the EU focuses particular attention on curbing the increase of the need for importing oil and natural gas. (*European Commission, 2007*)

Lithuania needs new carbon dioxide emission-free electricity production capacity to meet the challenges posed by climate change, competitiveness and reliability of operation, and to ensure economic growth and the Lithuanians' standard of living. The objective is to reduce the dependence on fossil fuels. The measures proposed by the European Commission in January 2008 with a view to curb climate change require that carbon dioxide emissions will be reduced by 20 % from the 1990 level in the EU area by 2020. The long-term target is to cut carbon dioxide emissions by 60–80 % in the developed countries by 2050. (*European Commission, 2008*)

1.4 STAGES OF ACTIVITY AND SCHEDULES

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

1. Construction and commissioning
2. Operation
3. 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 5–7 years (Figure 1.4-1). Operation time is approximately 60 years or even more. Decommissioning time depends on the decommissioning strategy and can last from 20 to 100 years.

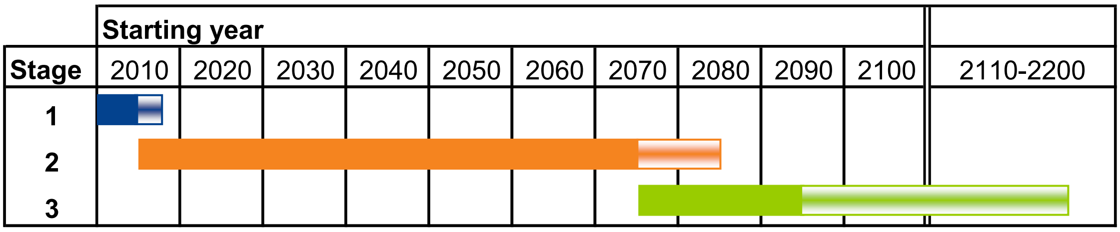

Figure 1.4-1. The estimated durations of the three main stages of the NPP project in case of one reactor.

In case of two or more reactors, it is assumed that construction work for the reactors would start two years after the previous one. In case of two reactors this would mean two years delay in all the different stages of the project.

The construction and commissioning stage of a reactor can be further divided into three stages: design adaptation and site preparation, actual construction time and start-up tests. Depending on the chosen reactor type, the durations of these stages vary so that total duration of the construction and commissioning is about 5–7 years (Figure 1.4-2).

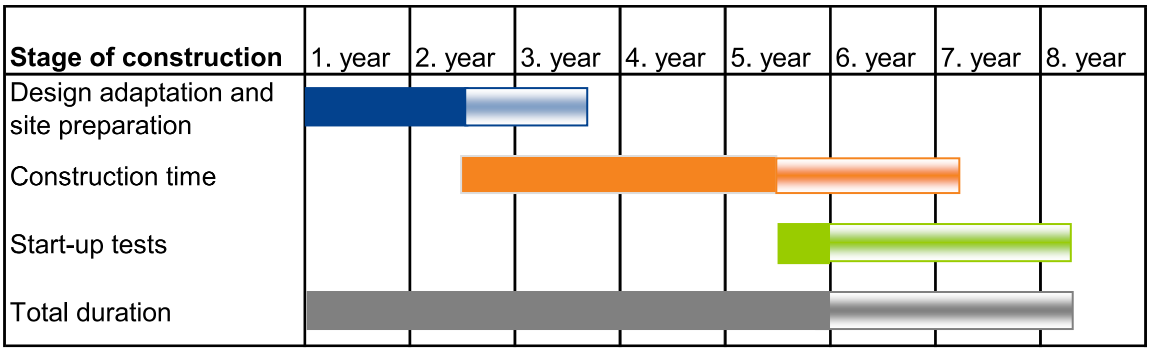

Figure 1.4-2. The durations of the different stages of the construction and commissioning of the new NPP.

1.5 ENERGY PRODUCTION

Information on planned production of energy is presented in Table 1.5-1.

Table 1.5-1. Energy production.

Energy type	Planned annual amount (output 1700 MW)	Planned annual amount (output 3400 MW)
Electrical energy, TWh/year	13	26
Thermal energy, TWh/year	0.4*	0.7*

* If heat for district heating of Visaginas will be produced.

1.6 DEMAND FOR RESOURCES AND MATERIAL

Demand for resources and materials during construction and operation of the new NPP is summarised in Table 1.6-1, Table 1.6-2, Table 1.6-3 and Table 1.6-4.

The estimations about the maximum consumption of main raw materials during the construction of the new NPP are presented in Table 1.6-1.

Table 1.6-1. Information about consumption of raw materials during construction of the new NPP (amounts are for 2 units 1700 MW each).

Material	Quantity
Earthworks (excavation)	1 400 000 m^3
Earthworks (fill materials)	1 300 000 m^3
Concrete; reinforced	640 000 m^3
Concrete; infill	60 000 m^3
Liner (skin and sleeves)	1 800 t
Turbine building (metal structures)	10 000 t + 46 000 m^2 metal cladding
Pools (Inox)	600 t
Steel reinforcement	90 500 t
Pre-stressing	3 970 t

Estimations on the fuel and energy consumption during the operation of the new nuclear power plant are presented in Table 1.6-2. The consumption of nuclear fuel will depend on the chosen reactor type.

Table 1.6-2. Information about fuel and energy consumption during operation of the new NPP.

Energy and technological resources	Measurement unit	Annual consumption amount (1 reactor)	Annual consumption amount (2 reactors)	Source
House load	MW	100	200	NNPP
Natural gas (if used for both reserve heat boilers and back-up power engines)	m^3	156 000	312 000	Lietuvos Dujos AB
Diesel fuel (if used for both reserve heat boilers and back-up power engines)	l	143 000	286 000	Fuel providers
Nuclear fuel (Uranium Dioxide UO_2)	t	29	58	Not defined yet
Nuclear fuel (Uranium Dioxide UO_2) "CANDU reactors"	t	102	204	Not defined yet

Table 1.6-3 presents information about chemical substances and preparations containing dissolvents that are possibly used during the operation of the new nuclear power plant.

Boric acid is used in the primary coolant of EPR reactors. It can possibly also be used in some support systems at the used fuel storage areas. Hydrazine is used in the component intermediate cooling system for deoxidization and corrosion prevention. Ammonia is used in the feed water system to control the pH value of the water. Lithium hydroxide is used in the primary circuit to control the pH value. Sulphuric acid (H_2SO_4) is used in demineralization as a recovery chemical of the ion exchangers. Sodium hydroxide is used as different solutions. It is used in the demineralization as a recovery chemical of the ion exchangers and in the feed water system to control the pH value of the water. Some lubricating oil will also be used.

Table 1.6-3. Information about chemical substances and preparations containing dissolvents possibly used during operation of the new NPP.

Name of the chemical substance and preparation containing dissolvents	Annual amount (1 reactor)	Annual amount (2 reactors)	Classification and labelling of the chemical substance or preparation [1]		
			Category	Hazard reference	Risk phrases
Boric acid (in EPR)	8 000 kg	16 000 kg	Xi	Irritant	R36/37/38
Hydrazine	22 m^3	44 m^3	R10; Carc. Cat. (2)	Flammable; Carcinogenic	R45 T; R23/24/25 C; R34 R43 N; R50-53
Ammonia	1 200 l	2 400 l	R10; T	Flammable; Toxic	R23 C; R34 N; R50
Lithium hydroxide	40 kg	80 kg	T	Toxic	R22 R23 R34
H_2SO_4	11 000 kg	22 000 kg	C	Corrosive	R35
NaOH (50 %)	3 200 kg	6 400 kg	C	Corrosive	R35
NaOH (10 %)	*dilution*	*dilution*	C	Corrosive	R35
NaOH (30 %)	*dilution*	*dilution*	C	Corrosive	R35
Lubricating oil (Addinol CLP 460 S)	0.5 m^3	1 m^3	T; Xn; Xi; N	Toxic; Harmful; Irritant; Dangerous for the environment	R22 R23 R24 R34 R38 R41 R43 R48 R50 R51 R53

Comment: 1 – According to the Law on Chemical Substances and Preparations (*State Journal, 2000, No. 36-987*) and Order of Classification and Labelling of Dangerous Chemical Substances and Preparations (*State Journal, 2001, No. 16-509; 2002, No. 81-3501*)

All the chemicals at the site will be handled and stored in appropriate manner to minimize the risk of environmental impact (Table 1.6-4).

Table 1.6-4. Storage of chemical substances and preparations containing dissolvents.

Name of the raw material, chemical substance or preparation	Amount for storage at site (1 reactor)	Amount for storage at site (2 reactors)	Storage manner [1]
Boric acid (in EPR)	10 t	20 t	Chemical storage facility, stored in separate tanks in containment basin
Hydrazine	17 t	30 t	
Ammonium	2 000 l	4 000 l	
Lithium hydroxide	0.01 t	0.02 t	Chemical storage facility, stored in purchase package
H_2SO_4	2 m^3	4 m^3	Chemical storage facility, stored in separate tanks in containment basin
NaOH (50 %)	2 m^3	4 m^3	
NaOH (10 %)	0.5 m^3	1 m^3	
NaOH (30 %)	0.2 m^3	1 m^3	
Lubricating oil	140 m^3	280 m^3	Stored in separate tank in containment basin

Comment: 1 – Underground tankage, tanks, structures, fuel storage areas covered with concrete for minimization of risk to environmental impact

1.7 SITE STATUS AND TERRITORY PLANNING DOCUMENTS

The considered sites for the new NPP (see Figure 1.7-1) are within an industrial land area allocated for State Enterprise Ignalina NPP (land parcel No. 4535/0002:5 and No. 4535/0003:2) (*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 No. PN 45/03-0071 and No. PN 45/03-0072, 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. IV-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. A 3 km radius sanitary protection zone (SPZ) is defined for Ignalina NPP site. 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. The sanitary protection zone for the new NPP is proposed in Section 7.10.2 of this EIA Report.

Figure 1.7-1. The proposed sites for the new NPP.

Alternative site 1 (see Figure 1.7-1 and Figure 1.7-2) 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. 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 a buffer storage facility for very low level waste (LLW) and a free release facility for the existing INPP are planned to be built at the southern border of alternative site 1. Construction of the free release building and security fence surrounding all the above mentioned objects has already started.

Figure 1.7-2. A view of alternative site 1 (east of current unit 2).

Alternative site 2 (see Figure 1.7-1 and Figure 1.7-3) is situated in an area west of the existing switchyard and is currently an 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. 108 (administrative building of State Enterprise “Visagino Energetikos Remontas“) is in the area. Better road connection and new railway connection have to be built to the site.

Figure 1.7-3. A view of alternative site 2 (west of the existing switchyard).

Present status of territorial planning documents in the area is as follows:

- Lithuanian territory general plan. The analyses of Lithuanian territory general plan and NNPP territory planning correlation issues have been made. Therefore, on the 7th of May in 2008 the Government of the Republic of Lithuania approved the resolution on addition of Lithuanian territory general plan's measures implementation plan concerning NNPP preparatory works.
- Utena county plan. It has been agreed and approved that the NNPP will be included in the Utena county plan. It is estimated that Utena county plan will be prepared and approved by the end of 2008.
- Visaginas, Zarasai and Ignalina municipalities plan. It has been agreed and approved (by the Visaginas municipality common council decision) that the NNPP will be included in the Visaginas, Zarasai and Ignalina municipalities plan. It is estimated that this plan will be prepared and approved by the end of 2008.
- NNPP detailed plan. The legal analyses of all sites, which may be needed for a NNPP construction, are under preparation. After analyses are ready, the changes and amendments of legal acts will be done and detailed planning will be initiated. It is estimated that the NNPP detailed plan preparation procedures will be completed in 2009.

1.8 UTILIZATION OF THE EXISTING INFRASTRUCTURE

After the present Ignalina NPP will be closed, some of the existing infrastructure in the area will be available for the new NPP. The possibilities to reuse parts of the existing infrastructure and equipment have to be examined as to its age, integration possibilities, interfacing of old and new infrastructure, requalification requirements, economic savings and various other aspects to assure the right selection. In this Section a preliminary evaluation of the existing infrastructure, which probably may be integrated into the new NPP, is presented. A more detailed examination will be done during the design stage of the new NPP. Since the compatibility of the existing infrastructure and equipment with the new NPP systems and the management of interfacing old and new infrastructure are some of the key issues to be examined, the supplier of the new NPP has to approve the integration of some of the existing infrastructure.

1.8.1 Hydraulic structures of Lake Druksiai

1.8.1.1 Regulation of the level of water

The level of water in Lake Druksiai is regulated to its present level. It is assumed that this regulation will continue also during the operation of the new NPP.

A blind earth dam was built in 1953 at the place of junction of the Apyvarde River to close the channel and the flood plain of the Druksa (called Drisvyata in Belarus) River (for a map, see Section 7.1). This dam secures the flow from the Apvardai Lake trough the Apyvarde River into Lake Druksiai. The crest and the slopes of the earth dam are lined with concrete on the side of the Apyvarde River and the slope is additionally strengthened with reinforced concrete plates. Also on the other side of the dam slope an additional embankment has been constructed. (*Ignalina Nuclear Power Plant, 2003*)

Also in 1953 a run-off regulation sluice, called “Object 500”, was built on the River Prorva to regulate the level of Lake Druksiai. Downstream from this a hydroelectric power plant (HPP), called “Tautu Draugyste”, was built between the Lakes Stavokas and Abaliai. The HPP building and the water intake openings are combined in one concrete block. The concrete block has three openings, two for turbine operation and a third one for discharge of excess water. Both Object 500 and the HPP are located in the area of the Republic of Belarus.

The HPP was taken out of operation in 1982 and the turbines have been disassembled. However, the level of Lake Druksiai is still regulated by the gates of the HPP. The Object 500 currently functions only as a transit structure. The radial gates of it are currently lifted to the maximum to secure full discharge. The water from Lake Druksiai flows into Lake Stavokas where from the water is discharged via the stop logs of the water regulating hydraulic structure based on the former HPP.

Under an agreement (signed on February 6th, 1995) concerning Object 500 and HPP “Tautu Draugyste” between the Governments of the Republic of Lithuania and the Republic of Belarus, responsibility for Object 500 has been transferred to the Republic of Lithuania, whereas any agreement concerning the proprietary rights of the HPP has not been signed till now.

In case the HPP and the earth dam of the diversion channel of the HPP are damaged for some reason, the level of the Lake Druksiai can be regulated with the Object 500.

1.8.1.2 Cooling water channels

The shape of the Lake Druksiai shore with its peninsula leads to an ideal arrangement for the cooling water inlet and outlet of the existing INPP. Lake Druksiai has the biggest depth close to the shore at the site of the water inlet. The water inlet is located at 6.6 meters depth (near the bottom) and is designed as an open channel with embankments in the lake part. From the power plant the water is let out through a closed reinforced concrete channel that then goes into an open channel. The channels are conjugated by a siphon structure.

The cooling water inlet and outlet were designed for four units, of which the two first units were realized. The channels are already partially excavated for the remaining, but not realised units. The outlet channel is designed for a maximum discharge of 170 m^3/s with 4 m filling level (*Ignalina Nuclear Power Plant, 2003*).

Cooling water inlet and outlet channels of the present INPP may be reused after renovation especially for alternative site 1 of the NNPP. The inlet channel would have to be somewhat extended. The maximum discharge from the new NPP would be 160 m^3/s. The distance from site 2 of the new NPP might be too long for the existing cooling water inlet channel to be used.

The renovation work can be carried out only after INPP Unit 2 is totally defueled. Modifications for avoiding crossing of old and new intake and outlet connections will have to be studied in detail during the design stage of the NNPP.

1.8.2 Water supply

Potable water is used for household and process water purposes in the new NPP. Potable water supply for the present INPP is outsourced to the State Enterprise "Visagino Energija", which also serves the town of Visaginas. Ground water is used as the source of raw water and it requires only a simple treatment of aeration and filtration to remove excessive iron. The total water production capacity is 31 000 m^3/d, but as one of the INPP units has already been closed and a drastic water consumption reduction has taken place in Lithuania, the present capacity in use is only about 10 000 m^3/d, and the daily average output is about 6 900 m^3/d. The treated water storage tanks have a capacity of 12 000 m^3, which provides for adequate stand-by supply volume. Continuous supply to the INPP is secured with a 500 kVA stand-by diesel generator. The plant instrumentation and automation will be upgraded in a project started in May 2008.

The maximum potable water demand of the new NPP is 1300 m^3/d (for more detail, see Section 7.1). "Visagino Energija", or its municipal successor, will thus have adequate capacity to supply all the needed potable water for the new NPP. Water demand in the town of Visaginas is still in decline, which also deallocates capacity for use in the NNPP.

Some of the potable water needs to be demineralised before it is used as process water. The inactive part of the existing demineralised water system of the INPP has a maximum capacity of 1080 m^3/d. The need for demineralised process water for the new NPP will be maximum 1000 m^3/d. Thus the existing system may be reused for the purposes of the new NPP.

1.8.3 Waste water treatment

"Visagino Energija" operates also the municipal wastewater treatment plant of the region. The non-radioactive wastewater of the INPP is lead to this plant to be treated. The plant has a capacity of 21 000 m^3/d, but it is in need of rehabilitation. A reconstruction project has been planned and its implementation was started in May 2008 by signing the construction contract. The new plant will have a capacity of 5 500 m^3/d. It will be based on an activated sludge biological process. The new plant will be able to meet the current Lithuanian and EU effluent standards. After the rehabilitation project has been finalized, the existing municipal wastewater treatment plant can be used to serve the new NPP. The present wastewater flow from the town of Visaginas is about 4 000 m^3/d and is decreasing. The new NPP will need a maximum of 600 m^3/d of household wastewater treatment capacity. The maximum capacity is needed during the construction stage of the NNPP. During normal operation the needed capacity will be about half of this (see Section 7.1).

For liquid radioactive waste, a new treatment facility will be built. The existing treatment facility will be decommissioned and with the building of a new one, total compatibility with the new NPP can be assured.

The surface water run-off system at the INPP site is designed to remove rain water from buildings' roofs and all the impermeable areas like roads, parking areas etc. Run-off water contains particles and can also be contaminated with hydrocarbons. The surface water run-off system is equipped with grease/oil separators (*Ignalina NPP Decommissioning Service, 2007*). This system may be reused when the run-off system following the surface relief of the new site fits to the old run-off system. The connection to the old wastewater pipes might be possible.

1.8.4 Waste management

The waste produced in the Visaginas area and in the INPP noncontrolled zone is placed in different landfills managed by different Lithuanian companies specialized in waste management. The amounts of conventional waste produced during the construction and during the operation stage of the new NPP (see Chapter 6) will be disposed of partially in the present infrastructures located in the area, and, because of the significant amounts of waste produced, part of this amount will have to be placed in new (or enlarged) landfills.

Within the frame of INPP decommissioning a new solid waste management and storage facility (SWMSF) has been contracted and its commissioning is scheduled for 2010 (*NUKEM Technologies GmbH and LEI, 2008*). Treatment of the INPP operational radioactive waste is expected to last until 2020. After 2020, and up to the end of the solid waste treatment facility's (SWTF) 30 years design life, the facility will be used to process INPP decommissioning waste. Technically a simultaneous treatment of both the INPP decommissioning waste and the NNPP operational waste could be viable. The design lifetime of the new solid waste storage facilities (SWSF) for short-lived and long-lived waste will be 50 years (until 2060). A new project for construction and commissioning of near surface repository (NSR) for short-lived low and intermediate level waste (LILW-SL) is underway. The site of the NSR has been confirmed at Stabatiske, in the vicinity of the INPP (*Resolution No. 1227 of the Government of the Republic of Lithuania, dated November 21, 2007*). When NSR will be commissioned and storage/disposal containers with LILW-SL from SWSF are transferred to the NSR, the containers with LILW-SL from NNPP can be temporary stored at SWSF until 2060. The more detail analysis of possibilities to reuse existing treatment and storage facilities for NNPP radioactive waste is presented in Section 6.2.2.

1.8.5 Electrical systems

The open power distribution system of the INPP will remain without changes during the decommissioning of the INPP and there will be no need to install a new electrical network. The condition of the existing power transmission lines depends on many factors and it should be checked before the start of the operation of the new NPP. Because of the importance of the transmission lines for the whole operation of the plant, it is economically viable to ensure the good condition of the transmission system and renew the parts of it that might be close to the end of their life span.

The 330/110 kV outdoor switchyard of the INPP has been in operation for nearly 25 years. By 2015 the major components will reach about 80 % of their expected life span. Due to the importance of the switchyard for the grid connection of the new NPP, it is suggested to replace the technology of the switchyard completely after the shutdown of the INPP. Following its rehabilitation, the switchyard may be reused. However, the location of it is relatively far from the site 1. In case site 1 is chosen for the implementation of the project, it should be studied, if it would be more convenient to build a completely new switchyard.

If the main transformers of the INPP should be reused, they would have to be relocated close to the turbine hall of the new NPP. The existing rail system of the INPP site area would make this operation manageable. However, the condition of the technology and its environmental feasibility should be studied more in detail before a decision on the reuse can be made.

1.8.6 Logistics

The main road connection from Visaginas to the INPP area can be used for the traffic also to the new NPP area. New access roads to the NNPP and to the relating facilities will have to be built when the site has been confirmed.

The site rail system of the INPP can be completely taken over and reused. Some smaller adaptations might be required.

1.8.7 Heat and steam sources

It is possible to use the existing heat only and steam only boilers of the INPP area for the purposes of the new NPP.

1.8.8 Monitoring systems

The existing monitoring systems and equipment will be used to the appropriate extent. However, they will be renewed according to the recent regulations and standards (see Chapter 9).

A seismic alarm and monitoring system of the INPP has been installed only recently. It comprises sensors located at distances of up to 30 km from the INPP which enables alerting prior to arrival of earthquake shock waves at the site. It identifies seismic events, does not interfere with other systems and its integration does not involve any risk for the NNPP supplier.

Also the INPP off-site radiological monitoring system could be reused. However, renovation of it should be considered within the first two decades of the operation of the NNPP.

1.8.9 Other

The old construction storage and lay down area from the early site construction days equipped with rails connecting several storage halls and parts of the area is still suitable for use during the NNPP construction phase in case site 1 is chosen for the implementation of the project. The existing buildings of this area need to be renovated.

The pressurized air supply system of the INPP could technically be integrated into the new NPP. However, the simultaneous use of pressurized air for dismantling Units 1 and 2 of the INPP and for the operation of the new NPP would create a need for some changes in the system.

The N_2-supply system of the INPP has been used for heat removal of the RBMK graphite core. The system can be reused in case the new nuclear power plant is a BWR.

The hydrogen electrolysis plant of the INPP could be reused for the same purpose as now, i.e. cooling of the stator coils of the electric generator. Its capacity should be sufficient.

The fire fighting hydrant system is a part of a safety system and this is why reuse of the pumping station only should be considered. If the pumping station would need to be disassembled and reassembled, the reuse of it should not be considered.

The pipelines that have been used to supply hot water to the Visaginas district heating system have been renovated and may be used if the NNPP will be used to produce heat for the district heating.

The storage hall of INPP for new fuel is not suitable to be reused for the NNPP. Reasons for this are the hall's location and building design, which might not comply with recent requirements.

New back-up diesel engines will be built for the NNPP.

The communication system of the INPP has been newly installed. However, it will most likely be outdated when the operation of the new plant starts and it might be economically more viable to build a totally new system than reuse the existing one.