REPUBLIC OF LITHUANIA
STATE NUCLEAR POWER SAFETY INSPECTORATE

PLAN OF STRENGTHENING NUCLEAR SAFETY IN LITHUANIA

Follow-up of the “stress tests” performed in European Union

Vilnius
2012

This page intentionally left blank

Table of Content

List of Abbreviations

AB	Accumulating Battery
ABWR	Advanced Boiling Water Reactor
AC	Alternate Current
ALS	Accident Localization System
AMC	Accident Management Centre
BDBE	Beyond Design Basis Earthquake
Bld	Building
CNS	Convention on Nuclear Safety
CPS	Control and Protection System
CSS	Commission of Safety Standards
DBA	Design Basis Accident
DBF	Design Basis Flood
DC	Direct Current
DE	Design Earthquake
DG	Diesel Generator
ECCS	Emergency Core Cooling System
EIA	Environmental Impact Assessment
ENSREG	European Nuclear Safety Regulators Group
EU	European Union
FASS	Fast Acting Scram System
FINAS	Fuel Incidents Notification and Analysis System
GE	General Electric (company)
GPS	Global Positioning System
IAEA	International Atomic Energy Agency
IRS	International Reporting System
LEI	Lithuanian Energy Institute
LOCA	Loss Of Coolant Accident
LSW	Low Salted Water
MCC	Main Circulation Circuit
MCE	Maximal Calculated Earthquake
MCR	Main Control Room
MSK-64	Medvedev-Sponheuer-Karnik seismic event classification scale

NEA	Nuclear Energy Agency
NF	Nuclear Facility
NISA	Japan Nuclear and Industrial Safety Agency
NPP	Nuclear Power Plant
NRC	US Nuclear Regulation Commission
NSFISF	New Spent Fuel Interim Storage Facility
NUSSC	Nuclear Safety Standards Committee
OEP	Organization of Emergency Preparedness
OIL	Operation Intervention Level
OSCE	Organization for Security and Co-operation in Europe
PEP	Plan of Emergency Preparedness
PNAE	Russian acronym for “Rules and Norms in Atomic Energy”
PNIIIS	Russian acronym for “Industry and Research Institute for Construction Engineering Survey”
PSAR	Preliminary Safety Analysis Report
RBMK	Russian acronym for “Channelized Large Power Reactor”
RPC	Radiation Protection Centre
RSMCR	Radiation Safety Monitoring Control Room
RUZA	Russian acronym for “Beyond Design Basis Accidents Management Procedure”
SAMS	Seismic Alarm and Monitoring System
SAS	Seismic Alarm System
SBO	Station Black-Out
SER	Site Evaluation Report
SF	Spent Fuel
SFA	Spent Fuel Assembly
SFISF	Spent Fuel Interim Storage Facility
SFP	Spent Fuel Pool
SFSF	Spent Fuel Storage Facility (SFISF or NSFISF)
SL	Seismic Level
SMS	Seismic Monitoring System
SSRM	Site Safety Review Mission
TSO	Technical Support Organisation
UAB	Lithuanian acronym for “Joint Stock Company”

UHS	Ultimate Heat Sink
UN	United Nations
VATESI	Lithuanian acronym for “State Nuclear Power Safety Inspectorate”
VNIPIET	Russian acronym for “Design and Research Institute of Complex Energy Technology”
WANO	World Association of Nuclear Operators
WENRA	Western European Nuclear Regulators Association

Introduction

The European Council of 24/25 March 2011 stressed the need to fully draw the lessons from recent events related to the accident at Fukushima Daiichi Nuclear Power Plant. The European Council decided that all European Union nuclear power plants should be reviewed on the basis of a comprehensive and transparent risk and safety assessment (“stress tests”). European Commission and the European Nuclear Safety Regulators Group (ENSREG) on 24 May 2011 confirmed the specification which defines technical scope and the process to perform the “stress tests” and their review [1].

The 15 European Union countries with nuclear power plants, including Lithuania, as well as Switzerland and Ukraine performed the “stress tests” and were subjected to the peer review. “Stress tests” were conducted by licensees and reviewed by the national regulators who prepared national reports. The national reports were peer reviewed through a process organised and overseen by ENSREG. Country visits were undertaken as part of the peer review. The national European regulators and the European Commission as ENSREG have endorsed the peer review report and the recommendations that finalised the “stress test” review [2] and published a joint statement dated 26 April 2012, which concluded that follow-up activities would occur through an Action Plan [3].

On 25 July 2012 ENSREG finalised the Action Plan [4]. The ENSREG Action Plan will assist in assuring that the conclusions from the “stress tests” and their peer review result in improvements of safety across European nuclear power plants. It will also assist, through further peer review, in ensuring that the recommendations and suggestions from the “stress test” peer review are addressed by national regulators and ENSREG in a consistent manner. According to ENSREG Action Plan, each national regulator will develop and make public available its National Action Plan associated with post-Fukushima lessons learned and stress test peer review recommendations and suggestions by the end of 2012. The final content of the National Action Plan should also take into account the relevant output from the 2nd Extraordinary Meeting of the Contracting Parties to the Convention on Nuclear Safety (CNS) [8].

Lithuania as the European Union Member State having nuclear fuel on Ignalina NPP site performed the “stress tests” and participated in a whole process of peer review: self assessment by licensee (action Ignalina NPP final report on “stress tests” [5]), review of the self assessment by national regulator (action of National final report on “stress tests” [6] by VATESI), peer reviews of the national “stress tests” reports, conducted by national and European Commission experts (action of Country peer review draft report of Lithuania), country review of Lithuania, conducted by experts delegated from ENSREG (finalising of the Country peer review report of Lithuania [7]).

The present work is prepared in the frame of follow-up of the “stress tests” performed at Ignalina NPP and it peer review. The goal of the work is to provide the plan of strengthening nuclear safety in Lithuania (hereafter – the Plan) in accordance with ENSREG Action Plan. The Plan provides general information about the current state of nuclear safety in Lithuania and measures taken to improve the nuclear safety in the light of Fukushima accident.

According to recommendations provided in ENSREG Action Plan, the Plan is based on the National final report on “stress tests” [6], ENSREG recommendations in the peer review of the “stress tests” final report [2], Country peer review report of Lithuania [7], recommendations from the 2nd Extraordinary Meeting of the CNS [8], [9], as well as additional recommendations derived from national reviews and related to post-Fukushima learned lessons.

The nuclear installations in Republic of Lithuania considered in EU “stress tests” specifications are opereted by license holder, which is state enterprise Ignalina Nuclear Power Plant (Ignalina NPP). The site of Ignalina NPP contains two power Units which are permanently shut down and currently are under decommisioning, Spent Fuel Interim Storage and New Spent Fuel Interim Storage facilities, which are in operation and under construction respectively.

Ignalina NPP Unit 1 and Unit 2 are in different states due to different decommissioning stages. The spent fuel from Unit 1 reactor is fully unloaded into Spent Fuel Pools (SFP), whereas in Unit 2 reactor about 1200 fuel assemblies still remain. However, the calculations show that Unit 2 reactor can not be critical even if all control rods are extracted from reactor core. Systems important to safety of SFP are in operation at Unit 1. Safety systems and systems important to safety of reactor and SFP are in operation at Unit 2.

As a result of the performed “stress tests” safety improvement measures have been planned and partly implemented at Ignalina NPP. These measures are described shortly at the end of appropriate subchapters and summarised in the last Part of Plan.

Current Lithuania’s National Energy Strategy is based on continuity of nuclear energy development by constructing new NPP (Visaginas NPP) for regional needs. The outcomes of “stress tests” and other measures, performed reacting to Fukushima Daichi accident, are of high importance for implementation of this project.

The structure and content of the Plan corresponds to the list of topics given in the documents “2nd CNS Extraordinary Meeting (August 2012) Structure” [10] and “2nd CNS Extraordinary Meeting (August 2012) Guidance for National Reports” [11] as well as recommendations given in the ENSREG documents “Action Plan: follow-up of peer review of the “stress tests” performed on European nuclear power plants” [4] and “Compilation of recommendations and suggestions: peer review of “stress tests” performed on European nuclear power plants” [12].

Part I gives overview of the measures considering “European Level Recommendations” and related national conclusions, addresses recommendations deriving from the main recommendations addressed in the conclusion of the ENSREG peer review final report and the measures that were found in the topical chapters [2]. Part I includes:

Chapter 1 “External Events” addresses the assessment of extreme situations caused by seismic, flooding, extreme weather conditions, and external fires;

Chapter 2 “Design Issues” provides assessment results in cases of loss of electrical power, loss of ultimate heat sink, loss of spent fuel pool cooling and overpressure of pressure boundaries and Accident Localization System;

Chapter 3 “On-Site Severe Accident Management and Recovery” gives the information concerning personnel resources and training, adequacy of procedures, multi-unit events, equipment availability.

Part II gives overview of the measures considering “CNS Level Recommendations” and related national conclusions, addresses the recommendations deriving from the outcome of 2nd Extraordinary Meeting of Convention on Nuclear Safety and includes:

Chapter 4 “National Organizations” provides information on and interactions among Lithuanian Government, Nuclear Safety Regulator, NPP owner and operator, Technical Support Organizations;

Chapter 5 “Off-Site Emergency Preparedness and Post-Accident Management” addresses the governmental and municipal activities concerned the crisis management, radiation protection, emergency response, communications, transparency/openness, etc.;

Chapter 6 “International Cooperation” provides the information about conventions, communications, arrangements with international organizations, sharing operating experience, application of international safety standards in Lithuania, etc.

Part III identifies additional topic linked to consideration of post-Fukushima learned lessons in view of construction of new nuclear power plant in Lithuania. Chapter 7 “Safety of New NPP” provides brief overview on evaluation of sites selected for Visaginas NPP.

Part IV includes Chapter 8 “Implementation of the Plan” and provides the table of measures included in the Plan. Chapter 8 “Implementation of the Plan” identifies timeline and revision of measures as well as necessary means and arrangements regarding transparency and public involvement, and responsibilities among the national institutions of Lithuania for implementation of the Plan.

Part I

European Level Recommendations

The peer review report of “stress tests” performed on European Nuclear Power Plants [2] identified four main areas to be considered for further improvement of safety of nuclear installations.

1st recommendation – European guidance on assessment of natural hazards and margins

The peer review report of “stress tests” states:

“The peer review Board recommends that WENRA, involving the best available expertise from Europe, develop guidance on natural hazards assessments, including earthquake, flooding and extreme weather conditions, as well as corresponding guidance on the assessment of margins beyond the design basis and cliff-edge effect.”.

Conclusion on planed WENRA guidance on assessment of natural hazards and margins

The guidance should be important and is the required document concerning assessment of safety of NPPs. The guidance should be analysed when it will be issued and applied if necessary for issuance of regulations and complimentary reviews of safety.

2nd recommendation – Periodic Safety Review

The peer review report of “stress tests” states:

“The peer review Board recommends that ENSREG underline the importance of periodic safety review. In particular, ENSREG should highlight the necessity to re-evaluate natural hazards and relevant plant provisions as often as appropriate but at least every 10 years”.

Conclusion on the adequacy of the Periodic Safety Review

The Law on Nuclear Safety of the Republic of Lithuania [25], Part 7 of Article 32 states:

“Not less frequently than every 10 years after the issuance of a permit referred to in sub-part 4 of part 2 of Article 22 hereof, the licence holder must perform a periodic safety analysis and justification and prepare a periodic safety evaluation report, which shall be submitted to the State Nuclear Power Safety Inspectorate for its review and assessment. (…) During the periodic safety analysis and justification it shall be established whether, considering the changes in legal regulation and the site and/or surroundings of a nuclear installation as well as taking into account ageing of structures, systems and components and other factors that might have an impact on safety, it is ensured that a nuclear installation complies with its design, legal acts and nuclear safety normative technical documentation requirements. If there are any inconsistencies detected, the licence holder shall prepare and implement necessary corrective measures which would assure the nuclear installation’s compliance with its design, as well as fulfilment of requirements of legal acts and nuclear safety normative technical documents (…)”.

Thus, no additional measures are needed to include in the Plan regarding to the adequacy of the Periodic Safety Review.

3rd recommendation – Containment integrity

The peer review report of "stress tests" states:

"Urgent implementation of the recognised measures to protect containment integrity is a finding of the peer review that national regulators should consider".

Conclusion on the adequacy of the containment integrity protection

Currently both Units of Ignalina NPP are permanently shut down and under decommissioning process. Pressure boundaries of both reactors are depressurized and there is no possibility to reach the pressure limits.

Actual sources of hydrogen in the current state of Ignalina NPP are water radiolysis in main circulation circuit (MCC) of Unit 2 and SFP of Unit 1 and Unit 2. The peer review of "stress tests" performed on Ignalina NPP [6] demonstrated that hydrogen monitoring and prevention of dangers concentration is assured by design and operational procedures. The hydrogen monitoring, concentration reducing and removing systems are still in operation until spent fuel is in reactor of Unit 2 and SFP's of Unit 1 and Unit 2.

The overpressure of pressure boundaries and Accident Localization System (ALS) of Ignalina NPP is impossible in the current state of NPP [6].

Thus, no additional measures are needed to include in the Plan regarding to the possible improvements on Ignalina NPP in areas of depressurization of the MCC in order to prevent high-pressure core melt, prevention of hydrogen explosions and prevention of containment overpressure.

The additional information about above mentioned issues are given in Chapter 2 "Design Issues" and Chapter 3 "On-Site Severe Accident Management and Recovery".

The issues concerning containment integrity, including post-Fukushima lessons learned shall be considered in design of new Visaginas NPP.

4th recommendation – Prevention of accidents resulting from natural hazards and limiting their consequences

The peer review report of "stress tests" states:

"Necessary implementation of measures allowing prevention of accidents and limitation of their consequences in case of extreme natural hazards is a finding of the peer review that national regulators should consider".

Conclusion on the adequacy of prevention of accidents resulting from natural hazards and limiting their consequences

As a result of "stress tests" carried out on Ignalina NPP [6], the several measures are identified in National final report on "stress tests" and included in the Plan, which are envisaged to increase plants robustness against natural hazards and limiting their consequences and would enhance plant safety. The list and additional information about identified measures are given in Chapter 1 “External Events”.

Activities included in the Plan deriving from the main European Level Recommendations

1. To consider the necessity of revision of the regulations applied to NPPs robustness against natural hazards (earthquake, flooding and extreme weather conditions), including revaluation of margins beyond the design basis and cliff-edge effects in compliance with planed WENRA guidance when it will be issued.

2. Review and update, if necessary, of existing nuclear safety regulations applied to Visaginas NPP, as well as ones which are in preparation in the field of:

   - natural hazards assessment, including evaluation of margins beyond design basis and cliff-edge effects;

   - design and beyond design basis issues, including provisions for power supply robustness, measures to protect containment integrity, instrumentation and control equipment robustness , including spent fuel pools issues;

   - severe accident management, including provisions for organization and arrangements to manage severe accidents, hydrogen management issue, severe accident phenomena issues, and measures to restrict the radioactive releases;

   - on-site emergency preparedness and response, including consideration of multi-unit events including long term effects, consideration of natural disasters leading to loss of infrastructure, concepts to manage large volumes of contaminated water, revaluation of communication and announcement capabilities.

   All other requirements dedicated to Visaginas NPP that encompass other fields should be checked in the light of post-Fukushima lessons learned and proposal of update if necessary.

1. External Events

Initial causes of Fukushima Daiichi nuclear power plant accident show the importance of comprehensive evaluation of external factors that may influence the nuclear power plant and importance of implementation of measures to eliminate or mitigate the risks that those factors pose in the design of the nuclear power plant.

1.1. Earthquakes

Characteristics of the design basis earthquake

Design basis earthquake is characterized by the design earthquake (DE, corresponding SL-1) and maximal calculated earthquake (MCE, corresponding SL-2).

Ignalina NPP site is situated in the area of Eastern Europe platform, which is considered as less active area, seismic activity is low here. On the base of instrumental investigations and assessment of historical records DE for the Ignalina NPP area was assumed of intensity of 6 points on the MSK-64 scale (peak ground acceleration is 0.5 m/s^2 = 0.05g). The MCE for the Ignalina NPP area is the intensity of 7 points on the MSK-64 scale (peak ground acceleration is 1.0 m/s^2 = 0.1g).

Dry Spent Fuel Storage Facility is designed taking into account the intensity of 6 points on the MSK-64 scale and New Spent Fuel Interim Storage – intensity of 7 points. Casks of CASTOR RBMK, CONSTOR RBMK-1500 and CONSTOR® RBMK-1500/M2 types are used in the existing Dry Spent Fuel Storage Facility and will be used in the New Spent Fuel Interim Storage Facility. These types of casks are designed to withstand vertical acceleration of 110g, 87g and 85g correspondingly. This considerably exceeds acceleration acting on the casks in case of DE and MCE.

Methodology used to evaluate the design basis earthquake

Special researches on study of seismicity of the Ignalina Nuclear Power Plant site were carried out in 1988. According to the results of these researches the Instrumental Researches Report was issued which includes summary data about the geological and tectonic structure as well as seismicity of the Ignalina Nuclear Power Plant site.

To assess the region seismicity, historical records since the year 1616 were observed and an attempt was made to assess these events according to scale MSK-64. It was accepted that the earthquakes with magnitude M=4.5÷4.6 are referred to the fracture zones of the first rank in the territory of the Baltic countries, while the earthquakes with magnitude M = 4.75 refer to the intersection nodes of the first and second rank zones. The intensity of a number of events, to which the intensity of more than 6 points was previously attributed, was called in question. Taking into account the most unfavourable conditions (the focus directly under the site), the conservative evaluation of values of maximum magnitudes leads to the conclusion that in case of local earthquakes their maximum intensity on the category II soils will be 6 points according to the MSK-64 scale.

Conclusion on the adequacy of the design basis for the earthquake

In order to assess possible seismic impacts of the local earthquakes on the soils of foundations of the Ignalina NPP Units 1 and 2, the maps of distribution of categories II and III soils were compiled and appropriate calculations and modelling were carried out.

The main result of micro zoning works is presented in Table 1.1-1. The conclusion is that the expected intensity of seismic impacts on categories II÷III soils is 6.5 points (for Unit 1) while on category II soils it is 6.0 points (for Unit 2). The accelerograms and other characteristics corresponding to these conditions were prepared. In 1991 VNIPIET (the general designer of the Ignalina NPP) took the data of PNIIIS institute as a basis and used these data to calculate floor accelerograms and floor response spectra of main Ignalina NPP structures.

Table 1.1-1. Micro zoning result

No	Number of Building, Structure	Intensity of seismic impact, point	Peak Ground Acceleration, m/s2
1.	Unit 1, Blds. A1, B1, V1, D1, D0	6.5	0.75
2.	Unit 2, Blds. A2, B2, V2, D2	6.0	0.60
3.	Pumping station, Blds. 120/1,2	6.0	0.60
4.	ECCS pressurized tanks, Blds. 117/1,2	7.0	1.00

The probabilistic characteristics of the Ignalina NPP main structures floor response spectra in case of earthquakes were calculated. According to the results of the analysis carried out, the probabilistic characteristics of available spectra correspond to the MCE. In case of DE the average of distribution is 2 times less.

In 2005, the International Nuclear Safety Centre carried out the assessment of the burden of the welded joints of pipelines Du 300 of the reactor cooling systems of the Ignalina NPP Unit 2 in the main operating modes and under external impacts. The researches carried out enable to draw the following certain generalizing conclusions regarding preliminary conservative estimations of stresses and efforts in the welded joints of the pipelines Du 300: stresses applied taking into account the operational and seismic loads under MCE do not exceed the permissible ones regulated by PNAE G-7-002-86 [13].

Spent Fuel Interim Storage Facility

Intensity of 6 points according to MSK-64 scale was taken as a design basis for the Spent Fuel Interim Storage Facility (SFISF). The appropriate peak ground acceleration is 0.6 m/s^2 = 0.06g. The following components of the SFISF were designed taking the DE into account:

- base slab of the casks storage site;
- shielding wall;
- radiation monitoring system equipment.

CONSTOR RBMK-1500 and CASTOR RBMK casks are designed to bear the impact of significant loads acting on them in case of the drop of a cask during handling operations or transportation to the SFISF.

In case of impact of MCE seismic loads the collapse of a shielding wall and partial blockage of the first row of the casks by the shivers with partial malfunction of heat removal path by means of natural air circulation. The thermal analysis of the casks for this case was not carried out.

New Spent Fuel Interim Storage Facility

New Spent Fuel Interim Storage Facility (NSFISF) is designed to withstand the intensity of 7 points according to the MSK-64 scale with the peak ground acceleration of 1.0 m/s^2 = 0.1g. Safety significant structures, systems and components of NSFISF are designed to bear the impact of MCE. The equipment for cask loading at the Unit 1 and Unit 2 are designed to bear the impact of MCE.

The case of CONSTOR® RBMK1500/M2 cask is designed to bear the significant overloads acting on it in case of design-basis accidents occurring due to the drop of a cask during the casks handling operations or transportation to the NSFISF.

In case of coincidence of the MCE impact and transportation of CONSTOR® RBMK1500/M2 cask from the power units to NSFISF using the special railway transporter, there is a possibility of tip-over of a cask in such a configuration, in case of which leak-tightness of the cask is ensured by elastomeric sealing of the primary lid. The tip over of the cask can cause disruption of the sealing and emission of gaseous fission products into the atmosphere. It will be necessary to study the impact on the environment, population and personnel with respect to this emergency scenario after the results of the calculations are obtained, and if needed, to introduce changes or supplements to the appropriate Ignalina NPP emergency preparedness documents.

Spent Fuel Pools

The calculations of reaction to the seismic impact were performed for Ignalina NPP buildings and heavy equipment. The results of strength analysis of Unit 2 Reactor Building (including spent fuel pools) structures show that the analyzed reinforced concrete walls and floors are capable to sustain the level of earthquake above MCE and meet the criteria of strength and crack resistance, specified in national regulation for construction.

During design of the main crane of Unit 1 and Unit 2 seismic loads was not taking into consideration. In the amendment to the Ignalina NPP design it is indicated that the cranes drop in case of MCE is impossible. The failures in the cranes operation can lead to a break in the work, i.e. to the hand-up of SFA, cartridges with SFA or baskets with the bundles of fuel elements during transportation and processing operations. Since all the operations are carried out under the water layer, the mentioned emergency conditions do not lead to an accident. The grabs for cartridges, SFA and baskets keep their strength in case of the MCE.

In case of impact of MCE seismic loads, the postulated failure of all support systems (radiation monitoring systems, power supply system, fire protection system, physical security system) does not cause violation of safety limits since the safety of storage of the spent fuel in protective casks is based on the passive principles:

- reliable assurance of the spent fuel arrangement geometry;
- heat removal from the walls of casks by means of natural air circulation;
- leak-tightness of a cask containment with application of the double-barrier system and absence of need for maintenance of the inert ambient of storage (helium).

Seismic Alarm and Monitoring System

Ignalina NPP has the Seismic Alarm and Monitoring System (SAMS) that intended to inform operators of Main Control Rooms about the coming earthquake and to record data of reactor building and main equipment reaction during earthquake.

SAMS consists of four external seismic stations at distance about 30 km from Ignalina NPP and one station on the Ignalina NPP site, see Figure 1.1-1. Data are transferred from external stations using radio link. Besides, 18 acceleration sensors are installed in the reactor buildings and on steam drum separators.

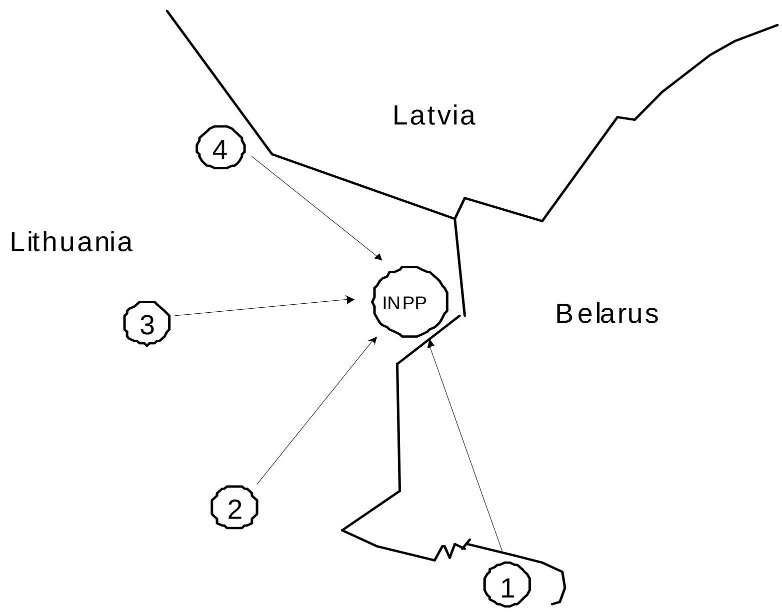

Figure 1.1-1. Layout of the seismic stations

1 – station in Didžiasalis (Navikai village), 2 – station near Ignalina (Ažušilė village), 3 – station in Salakas, 4 – station in Zarasai (Dimitriškės village)

Indirect effects of the earthquake

Possible loss of external power supply and loss of ultimate heat sink caused by any circumstance including an earthquake is discussed in Section 2 below.

An earthquake may not prevent access of personnel, diesel fuel and additional equipment to the NPP site. Access delay no more than 8 hours is possible; this time is uncritical for NPP safety.

No other external effects impact the Ignalina NPP safety.

Activities included in the Plan to improve the plant protection against an earthquake

As a result of "stress tests" carried out, the following measures are proposed by Licensee, which could be envisaged to increase plants robustness against seismic phenomena and would enhance safety of nuclear instaliations:

1. To evaluate the spent fuel cask tip over in case of earthquake during transportation and to assess radiological impact on the environment, personnel and population. This activity is planned by Licensee to be completed in 2013.
2. To consider the necessity of improvement of emergency preparedness procedures or updating those after confirmation of the calculation results of the spent fuel cask tip over during transportation. This activity is planned by Licensee to be completed in 2014.
3. To assess the robustness of accident management centre of organization of emergency preparednness against an earthquake. If needed, to develop measures to improve the robustness of accident management centre. This activity is planned by Licensee to be completed in 2013.
4. To consider the possibility of the seismic alarm and monitoring system application for formalization of the emergency preparedness announcement criterion and to include this criterion in the operational manual of the seismic warning and monitoring system. This activity has been implemented by Licensee in 2012.
5. To provide data transfer of the seismic alarm and monitoring system to the computer information system of organization of emergency preparednness, i.e. to the accident management centre, technical support organization and radiation safety monitoring control room and to update corresponding procedures of organization of emergency preparednness. This activity is planned by Licensee to be completed in 2012.
6. To assess the possibilities of the emergency removal and repair works by organization of emergency preparednness for beyond design-basis emergency scenarios related to the level of earthquake above maximal calculated earthquake and resulting in the cracks or collapse of the construction structures of the operating spent fuel interim storage facility and new spent fuel interim storage facility, including casks blockage by debris, as well as cracks or collapse of the construction structures of the "hot cell" of the new spent fuel interim storage facility during the works with spent nuclear fuel in the "hot cell". This activity is planned by Licensee to be completed in 2012.

1.2. Flooding

Characteristics of the design basis flood (DBF)

The lake Drūkšiai serves as a natural water source of the cooling water for the power plant. The length of the lake is 14.3 km, the maximum width – 5.3 km, perimeter is 60.5 km. The total lake area is 49.32 km^2. The maximum depth of the lake is 33.3 m, the average – 7.6 m, dominant – 12 m. The total amount of water in the lake is about 369 million m^3. The area of filtration (drainage) of the lake is 564 km^2. There are a lot of lakes in the neighbourhood of the Ignalina NPP. The total surface of water (without Lake Drūkšiai) makes 48.4 km^2. The density of rivers is about 0.3 km/km^2.

Water levels in the Lake Drūkšiai relatively the Baltic Sea level are: normal 141.6 m, minimal 140.7 m, maximum 142.3 m. There are three hydro-engineering structures regulating the Lake Drūkšiai water level: the water level regulating Structure 500, Blind earthen dam (dike) of River Drisviata (Structure 501), and Dam of hydroelectric power station “Druzhba Narodov”. Levels of all those structures are specified in Table 1.2-1. These levels were rechecked and documented in the period since 16 September till 17 October, 2011. Ignalina NPP buildings and structures of interest are situated at levels indicated in Table 1.2-2.

Table 1.2-1. Levels of hydro-engineering structures in the Lake Drūkšiai

	Level, m
Slope and concrete platform of the water regulating Structure 500	143.2 – 143.3
Blind earthen dam (dike), Structure 501	142.7 – 142.8
Dam of hydroelectric power station “Druzhba Narodov”	142.5 – 142.6

Table 1.2-2. Levels of Ignalina NPP buildings and structures

	Level, m
Service water pump stations (the lowest level of NPP buildings)	144.0
Turbine building	146.5
Reactor building	148.5
Spent Fuel Storage Facility	149.0
Building of diesel generators	149.5
330/110 kV switchyard	153.7
New Spent Fuel Interim Storage Facility	155.5

Comparison of all levels is presented in Figure 1.2-1.

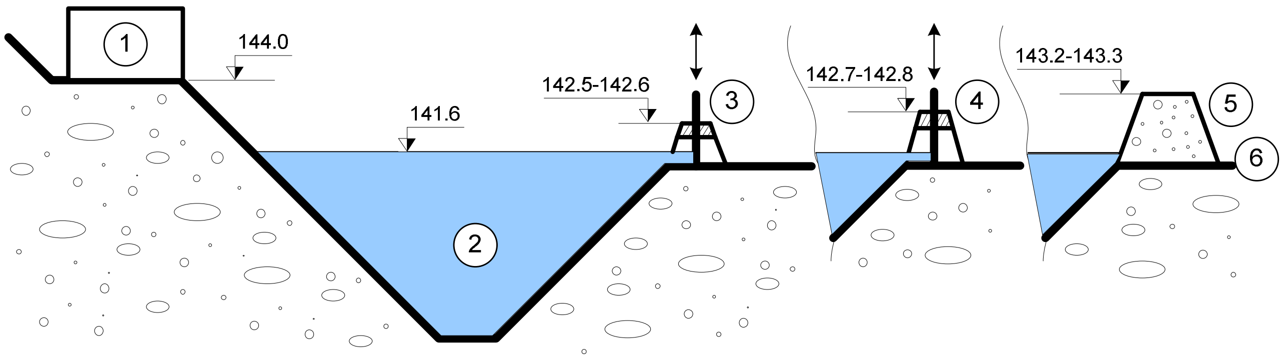

Figure 1.2-1. Levels of Lake Drūkšiai and hydro-engineering structures

1 – Service water pump station, 2 – Lake Drūkšiai, 3 – dam of hydroelectric power plant “Druzhba narodov”, 4 - water regulating Structure 501, 5 - blind earthen dam, Structure 500, 6- high-water bed of river Drysviaty

Methodology used to evaluate the design basis flood.

Tsunami is impossible at the Lake Drūkšiai. The methodology to evaluate the design basis flood is based on the comparison of theoretically possible the highest level of Lake Drūkšiai (the level of hydroelectric power station “Druzhba Narodov” dam) and levels of Ignalina NPP buildings and structures given in Table 1.2-2.

Conclusion on the adequacy of protection against external flooding

Comparing the levels of Lake Drūkšiai and Ignalina NPP buildings and structures, the conclusion may be made that external flooding of Ignalina NPP buildings and structures is impossible. In the worst case theoretically possible the highest level of the lake cannot exceed the level of hydroelectric power station “Druzhba Narodov” dam i.e. always lower than levels of all structures and buildings of Ignalina NPP.

During uncontrollable abnormal rise of water level in Lake Drūkšiai, at the most negative flooding scenario, irrespective of the cause of its occurrence, the water level in Lake Drūkšiai cannot reach the marks, which could lead to the flooding of the Ignalina NPP buildings and facilities. Licensee does not need any additional measures to ensure that plant systems, structures, and components that are needed for achieving and maintaining the safe shutdown state, as well as systems and structures designed for flood protection, remain in operable condition.

There is no flooding threat outside the plant, including preventing or delaying access of personnel and equipment to the site.

1.3. Extreme Weather Conditions

Verification of weather conditions

The Ignalina NPP site is located in the Eastern Europe, in the continental climate zone. One of the main features of the climate of the area is the fact that cyclones are not formed there. Cyclones in the majority are related to the polar front and determine the constant movement of air masses. They are formed in the middle latitudes of the Atlantic Ocean and they move from the West to the East over Eastern Europe, thus, the NPP region very often occurs on the crossroads of cyclones that bring moist sea air. Since the change of marine and continental air masses is frequent, the climate of the region can be considered as transitional – from the maritime climate of Western Europe to the continental climate of Eurasia. An average annual precipitation near the Ignalina NPP in 1988-2007 years was about 665 mm. A snow cover in the region rests for 100-110 days a year. An average snow depth is 16 cm. The annual average wind speed is about 3.5 m/s, the average annual temperature is +5.5°C. The average calculated temperature of the coldest five-day period is –27°C.

Specifications for extreme weather conditions

Extreme weather conditions are rare in the vicinity of the Ignalina NPP site. During the storm in 1998 the wind speed of 33 m/s was registered. The absolute registered temperature maximum is +36°C, the absolute minimum is –40°C.

Assessment of the design basis conditions

Weather conditions used as the design basis of Ignalina NPP are based on the area climate conditions taking into account necessary margins. Extreme external temperature, wind speed and atmospheric precipitates, including their combinations, are considered in the plant design in accordance with construction regulations. Design basis conditions correspond to the real weather conditions in the area of the Ignalina NPP site.

As both units of Ignalina NPP are shut down, heating of NPP buildings is provided from the newly built boiler-house. The Programme of the NPP preparedness to faults of the heat supply during the heating period has been developed by Licensee. The initial conditions, organizational and technical measures on prevention and elimination of failures of the heat supply, maintenance of the positive temperatures in the Ignalina NPP buildings and rooms, in which the safety-related systems are located, including the systems of nuclear fuel storage and treatment at Ignalina NPP Units 1 and 2, are included in the programme up to initiation of the Ignalina NPP Plan of emergency preparedness.

Conclusion on the adequacy of protection against extreme weather conditions

Ignalina NPP operation during 26 years and additional 3 years of post-operational shutdown state confirm the adequacy of the plant protection against extreme weather conditions.

1.4. External Fires

Assessment of the design basis conditions

According to the results of analysis carried out in the Ignalina NPP Unit 2 Safety Analysis Report [14], probability of forest fires in Ignalina NPP surroundings is high enough – 1.0E-02 to 1.0E-05 event per year and cannot be excluded as negligible.

The territory of Ignalina NPP site is surrounded with the concrete fence of 3 m height. The area of 20 m width around the fence is constantly cleared from trees and bushes. The car parking area is situated outside the fence at distance of at least 100m.

According to procedures in case of fire occurrence in surrounding wood or car parking, the information will be promptly transmitted to the Visaginas Fire Service that will carry out its functions. The Plan of Management and Liquidation of Extreme Situations of the Extreme Situation Control Centre of Visaginas town is a part of Ignalina NPP Emergency Preparedness Plan.

Conclusion on the adequacy of protection against external fires

Transition of an external fire into internal fire is practically impossible.

2. Design Issues

2.1. Loss of Electrical Power

External power supply design

Ignalina NPP is linked with external power supply via 110/330 kV switchyard. The switchyard is connected to 330 kV grid using 6 power lines and with 110 kV grid using 2 power lines. Off-site AC power supply may be provided from any power line of 330 kV or 110 kV. Connection between 330 kV switch-yard and 110 kV switch-yard is carried out via two coupling autotransformers AT-1, AT-2. Power rating of each autotransformer is 200 MVA.

Two block transformers, 4 operation transformers and 4 start-up auxiliary transformers are installed at each Unit. At present the consumers are powered via start-up auxiliary transformers from the 110 kV grid. Block transformers and operation transformers are in standby mode.

Internal power supply design

Each Unit of Ignalina NPP is equipped with 6 diesel generators of 5600 kW each. Currently all diesel generators at Unit 1 are taken out of operation and isolated, 3 of them are conserved and 3 are under dismantling process. All 6 diesel generators at Unit 2 are in operation.

Each Unit of Ignalina NPP is equipped with 7 accumulating batteries. 6 batteries provide power supply for instrumentation, communication and radioactivity monitoring systems and the seventh battery mostly for emergency lighting. Currently 6 batteries at Unit 1 are taken out of operation and one battery is still in operation. All 7 batteries at Unit 2 are in operation. Capacity of instrumentation batteries is enough for at least 12 hours and lighting battery for at least 9 hours without recharging.

Communication facilities and computers of the Accident Management Centre can be powered by the independent stationary diesel generator, which is installed in the OEP auxiliary room.

Two additional mobile diesel generators and special connecting points are foreseen.

Loss of off-site power

If the off-site power supply is lost, all diesel generators are starting automatically and provide important to safety consumers with power supply. The 6 kV voltage consumers and the 0.4 kV voltage consumers (through the step-down transformers) will be powered with no more than 15 seconds interruption.

The power rating of each diesel generator is 5600 kW. The designed volume of fuel tank is enough for 72 hours operation of each diesel generator without refuelling to ensure safe shutdown and cooling of the reactor. Since the Unit 2 reactor is permanently shutdown and is at a stage of defuelling, a set of consumers important to safety are taken out of operation so the fuel amount is ensured for more than 72 hours operation of diesel generators. The time is assessed in the case of most loaded DG-9. It has the load reduction factor of 1.8 now and can operate without refueling about 130 hours i.e. no less than 5 days. With the refueling the operation time is not limited. In order to carry out the refueling, the fuel supply contract was concluded in January 2012.

Diesel generators are qualified for the design basis earthquake with intensity of 6 points.

Since all diesel generators and 6 out of 7 batteries of Unit 1 are taken out of operation, in case of loss of external power supply all Unit 1 AC power consumers will be de-energized except the radiation monitoring system, which is common for two units, located at Unit 1 but powered from DG-7 of Unit 2. General DC consumers and emergency lighting of Unit 1 will be powered from the battery 1AB-7 that still in operation. Power supply of Unit 1 instruments of water temperature and level in the storage pools was modified to provide power from DG-7 of Unit 2 or from mobile diesel generator connected to Unit 2. This design modification was implemented in December 2011.

Spent Fuel Storage Facilities (SFSF) will be de-energized in case of loss of off-site power. However it will not violate the safety limits because the spent fuel in casks is cooled using natural convection without any power supply. Radiation monitoring and security systems of SFSF may be powered from own independent sources.

In case of loss of external power supply the consumers of service water of Unit 1 are provided with service water by operating pumps of Unit 2. Unit 1 water- and foam-extinguishing systems are operated using Unit 2 motors which are powered from diesel generators.

Actions and interactions on restoration of Ignalina NPP external power supply are prescribed in proper instructions of the Lithuanian Energy System [15] and NPP [16]. In the Lithuanian Energy System instruction [15], the time needed for restoration of NPP power supply after possible total shutdown of the Lithuanian Energy System is approximately 30 minutes. Various variants of power supply restoration are foreseen including start-up of Pļaviņas Hydro Power Plant in Latvia and Kruonis Pumped Storage Plant in Lithuania.

Loss of off-site power and loss of the ordinary back-up AC power source

If the off-site power supply and all diesel generators are lost (total station blackout), instrumentation, communication and radioactivity monitoring systems and emergency lighting of Unit 2 will be powered from 7 batteries without interruption of supply. General consumers and emergency lighting of Unit 1 will be powered from one battery. The rated capacity of the Vb2421 VARTA type battery is 2100 A×h at the 10 hour rate current 210 A. The discharge time of each battery for the full design load required for the emergency shutdown and cooling of the reactor is not less than one hour. Since Unit 2 reactor is shut down and is at the stage of defueling and some consumers are taken out of operation, the batteries discharge time will be considerably more. The discharge times for 6 main batteries of Unit 2 were evaluated; evaluation results are in the range between 12.2 hours and 57.7 hours for different batteries. The evaluation is performed applying the conservative approach.

The discharge times for the actual load of Unit1 and Unit 2 seventh batteries powering general consumers and emergency lighting are 9.4 hours for 1AB-7 and 19.3 hours for 2AB-7. This time is enough for restoration of the off-site power supply.

Batteries are qualified for the design basis earthquake with intensity of 6 points.

Loss of off-site power and loss of the ordinary back-up AC power sources, and loss of permanently installed diverse back-up power sources

If all power supply sources (i.e. all external power lines, all diesel generators and all batteries) are lost, two additional mobile diesel generators will be connected and started manually. One of them will provide power supply for instrumentation and radioactivity monitoring systems, other one for communication system. Connecting points for those diesel generators are installed on walls of the Unit 2 building and the administrative building. Operations with mobile diesel generators are described in instructions, estimated time of connection and start-up is one hour. Both mobile diesel generators are included in maintenance and testing program. The involved personnel are trained. The last complex testing of these diesel generators was carried out on 14 April 2011.

Conclusion on the adequacy of protection against loss of off-site power and SBO

Considerable redundancy of external power lines supplying Ignalina NPP with electricity is provided. This redundancy ensures restoration of the external NPP power supply in approximately 30 minutes.

Stationary diesel generators, batteries and mobile diesel generators provide the adequate protection of Ignalina NPP against loss of off-site power and total station blackout. Diesel fuel amount and capacity of batteries are enough to provide power supply for the time much more than needed to restore off-site power supply.

Activities included in the Plan to improve the plant protection against loss of off-site power and SBO

As a result of “stress tests” carried out, the following measures are proposed by Licensee, which could be envisaged to increase plant protection against loss of off-site power and SBO and would enhance plants safety:

1. To provide the power supply of water temperature and level instruments in the storage pools of both units from disiel generator No. 7 of unit 2 or from the mobile diesel generator connected to unit 2. This measure was implemented in December 2011.
2. To provide the diesel fuel supply for assuring long-term operation of diesel generators. The contract on the supply of diesel fuel was made with fuel company in January 2012.

2.2. Loss of reactor Ultimate Heat Sink

Design basis

The main ultimate heat sink for the Unit 2 reactor is Lake Drūkšiai. Heat abstraction to the lake is provided by the following supporting systems:

- Blow-down and Cooling System,
- Intermediate Circuit,
- Service Water Supply System.

The alternative ultimate heat sink for the Unit 2 reactor is the environment (atmosphere). In the case of the Unit 2 reactor, diffusion of heat to the environment occurs during ventilation of rooms where the equipment and pipelines are located, during the reactor space blowdown with compressed air, during evaporation of water from the coolant circuit in Accident Localisation System and periodic makeup of the main circulation circuit.

Heat removal from the reactor

Different modes of residual heat removal from reactor are used:

- Mode of cooling water natural circulation;
- Mode of cooling water forced circulation;
- Mode of cooling water broken natural circulation;
- Mode of cooling water bubbling.

The correspondence of the ultimate heat sinks to the various modes of heat removal from Unit 2 reactor is presented in Table 2.2-1.

Table 2.2-1. Ultimate heat sink from the reactor

Mode of heat removal from the reactor	Ultimate Heat Sink
Non-boiling mode of coolant natural circulation	main + alternative
Boiling mode of coolant natural circulation	alternative
Forced circulation of the coolant	main + alternative
Broken natural circulation of the coolant	alternative
Coolant bubbling	alternative

Monitoring of water temperature in reactor is carried out using thermocouples installed in the central tubes of some fuel assemblies. Monitoring of water level in reactor is carried out by at least two out of possible four different methods using design and additional level meters.

Assessment of the decay heat value in the Unit 2 reactor was carried out. The main result of the assessment and of the calculation of the Unit 2 reactor heating-up process is as follows: if the offsite power supply and all diesel generators are lost, the critical temperature of the fuel cladding (700^{o}C) in the Unit 2 reactor will be reached after 6 days. Taking into account, that the Unit 2 reactor is partly defueled with less than 1200 (of 1661) fuel assemblies in the reactor and more than 3 years have passed since the reactor was shutdown, critical temperature of the fuel cladding (700^{o}C) will be reached after significantly larger period of time.

Conclusion on the adequacy of ultimate heat sink from the reactor

If the ultimate heat sink is lost, Ignalina NPP staff has enough time and necessary means to prevent cliff edge effects. In case of total SBO and loss of ultimate heat sink to prevent the subsequent fuel degradation the appropriate design modification is developed at Ignalina NPP that provides an additional diverse source of cooling water. In this case the supply of the artesian water to Ignalina NPP Unit 2 from the domestic potable water system is foreseen. Pumps of the domestic potable water system have own independent diesel generator that increases the reliability of protection against loss of UHS.

Thus, no additional measures are required to increase robustness of Ignalina NPP in case of loss of ultimate heat sink.

2.3. Loss of Spent Fuel Pool Cooling

Design basis

The main ultimate heat sink for spent fuel pools of both Units is Lake Drūkšiai. Heat abstraction to the lake is provided by the pump-cooling plants.

The alternative ultimate heat sink for spent fuel pools of both Units is the environment (atmosphere).

Heat removal from spent fuel pools

Heat is removed from spent fuel assemblies located in the spent fuel pools (SFP) of each Unit by means of cooling of water in pools using the operating pump-cooling plants. If for any reason it is impossible to use pump-cooling plants, the alternative mode provides heat removal during a limited period of time. In this case, diffusion of heat to the environment occurs via evaporation of water from the surface of pools and periodic makeup of SFP, and by means of water exchange in SFP using the drain waters and contaminated LSW collection and pumping system, and makeup system.

Water from SFP flows under gravity through the pipelines tied in the top part of each pool to the heat exchangers where it is cooled down by the service (lake) water to about 30°C. After the heat exchangers the water flows to suction inlets of pumps and by the operating pumps returns through the regulation unit to the lower part of the SFP.

The temperature of water in the SFP is maintained within the range of 20 to 50°C. The limit of safe operation is 60°C. The temperature regime is determined by the quantity of heat exchangers connected to the service water, quantity of the operating pumps, the flow rate of the pool water and flow rate of the service water through the heat exchangers. In case of the maximum values of the decay heat in the pools, two pumps and three heat exchangers are constantly in operation. The SFP pump-cooling plants can be switched-off without time limitations if the temperature of water in all the storage pools is below 45°C. If the pump-cooling plant is switched-off, the temperature of water in any SFP is reduced by the water exchange in this SFP.

Since the decay heat in Unit 1 SFP is low, the Unit 1 SFP pump-cooling plant is switched off. Thus the temperature and chemical conditions of water in the SFP are maintained by the periodic water exchange. The Unit 2 SFP pump-cooling plant is constantly operating in a nominal mode (2 pumps, 2 heat exchangers) and ensures the operational values of the water temperature in the SFP.

The correspondence of the ultimate heat sinks to the various modes of heat removal from the SFP of both Units is presented in Table 2.3-1.

Table 2.3-1. Ultimate heat sink from spent fuel pools

Mode of heat removal from the reactor	Ultimate Heat Sink
Operating Pump-Cooling Plant	main
Non-operating Pump-Cooling Plant	alternative

Calculation of the temperature regime and level of water in the SFP of Units 1 and 2 was carried out.

If the offsite power supply and all diesel generators are lost, main results of temperature and level calculations are:

- The critical temperature of water (100^{o}C) in the Unit 1 spent fuel pools will be reached after 16 days;
- The critical temperature of water (100^{o}C) in the Unit 2 spent fuel pools will be reached after 7 days;
- The critical low level of water in the Unit 2 spent fuel pools corresponding of top of the fuel in assemblies will be reached after 40 days;
- The critical low level of water in the Unit 2 spent fuel pools corresponding of top of the fuel in transport 102-places covers will be reached after 15 days.

Conclusion on the adequacy of heat removal from spent fuel pools

If the heat removal from spent fuel pools is lost, Ignalina NPP staff has enough time and necessary means to prevent cliff edge effects. In case of total SBO and loss of heat removal from spent fuel pools to prevent the subsequent fuel degradation the appropriate design modification is developed at Ignalina NPP that provides an additional diverse source of cooling water. In this case the supply of the artesian water to Ignalina NPP spent fuel pools from the domestic potable water system is foreseen. Pumps of the domestic potable water system have own independent diesel generator that increases the reliability of protection against loss of heat removal from spent fuel pools.

Activities included in the Plan to improve the plant protection against loss of heat removal from spent fuel pools

As a result of "stress tests" carried out, the following measures are proposed by Licensee, which could be envisaged to increase plant protection against loss of heat removal from spent fuel pools and would enhance plant safety:

1. To evaluate the capacity for work of water temperature and level instrumentation in the spent fuel storage pools as well as radiation detectors in the spent fuel storage pools halls of both units in conditions of beyond design-basis accident. If needed, to develop the appropriate improvement measures. This activity is planned by Licensee to be completed in 2012.
2. The special sub-module of the plant computer information system will be developed to provide information about the water temperature and level measurements in spent fuel

storage pools as well as radiation level in the spent fuel storage pools halls from both units during and after beyond design-basis accident. The data of water temperature and level measurements in the spent fuel storage pools as well as radiation level measurements in the spent fuel storage pools halls will be transferred to the computer information system of main control room, accident management centre of organization of emergency preparednness and VATESI. This activity is planned by Licensee in accordance with modification schedule, to be completed in 2013.

3. To examine existing documents concerning the spent fuel storage pools safety. To review management procedures and manuals of beyond design-basis accidents in the spent fuel storage pools. To evaluate planned and implemented modifications related with the spent fuel storage pools safety. To determine additional measures if needed. This activity is planned by Licensee to be completed in 2012.

2.4. Overpressure of Pressure Boundaries and Accident Localization System

Design basis

Two units of Ignalina NPP have the reactors of RBMK-1500 type. “RBMK” is the Russian acronym for “High Power Channel-type Reactor”. It is boiling-water reactor with graphite moderator. The reactors used low-enriched Uranium-235 fuel. Designed thermal power of the RBMK-1500 reactor is 4800 MW, what corresponds to 1500 MW electrical power. Authorised power was 4200 MW and 1350 MW accordingly.

Each nuclear fuel assembly is located in a separately cooled fuel channel (pressure tube). There are a total of 1661 of such channels and the cooling water flow rate is equally divided among associated feeder pipes. After passing the core, pipes are brought together to feed the steam-water mixture to the separator drums.

RBMK-1500 is one coolant loop unit. Saturated steam with pressure of 6.5 MPa, diverted to the turbines, is generated directly in the reactor channels and separated in drum separators. Simplified Ignalina NPP heat diagram is shown in Figure 2.4-1. Water, cooling the reactor (1), passes the core, boils and partially evaporates. Water-steam mixture enters the drum separators (3), located above the reactor. The separated steam from drum separators enters the turbines (4). Spent steam condensates in the condensers (6). The condensate is fed by condensate pumps (7) to deaerators (8) and returns to the drum separator by the feed-water pumps (9). Water from drum separator is delivered for the core cooling by the main circulation pumps (10) and there it partially evaporates again.

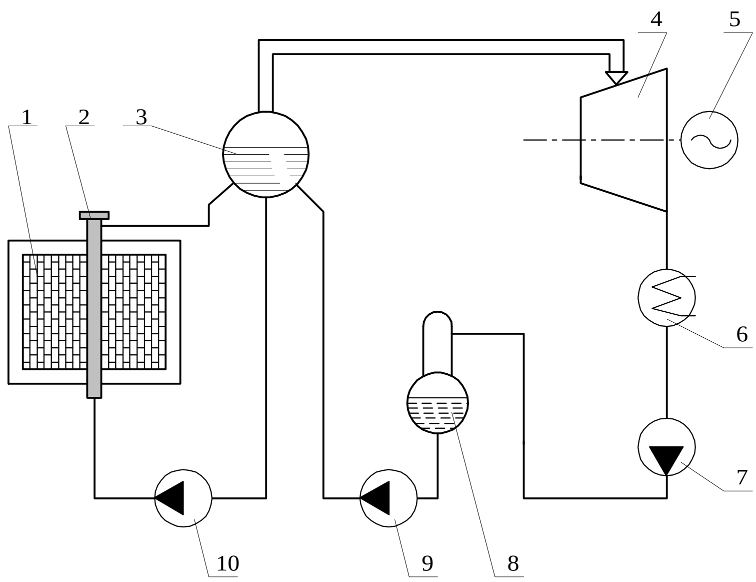

Figure 2.4-1. Simplified Ignalina NPP heat diagram

1 – reactor, 2 – fuel channel with FA, 3 - drum separator, 4 – turbine, 5 – generator, 6 – condenser, 7 - condensate pump, 8 – deaerator, 9 - feed-water pump, 10 – main circulation pump

Ignalina NPP units, like all NPPs with RBMK reactors, do not have containment. At each Unit there is the Accident Localization System (ALS) that functions are as a containment to localize high pressure and fission products in case of LOCA or another DBA. ALS consists of number leak-tight compartments and Accident Localization Tower.

Assessment of the overpressure of pressure boundaries and ALS

Currently both Units of Ignalina NPP are permanently shut down and under decommissioning process. Pressure boundaries of both reactors are depressurized and there is no possibility to reach the operation pressure or even more so.

Conclusion on the adequacy of protection against overpressure of pressure boundaries and ALS

The overpressure of pressure boundaries and ALS of Ignalina NPP is impossible in the current state of NPP and no protection against overpressure is needed.

3. On-Site Severe Accident Management and Recovery

The special structures – Organization of Emergency Preparedness (OEP) and Emergency Preparedness Headquarters – were established at Ignalina NPP. The OEP is staffed by the personnel of all NPP directorates, departments and service offices on the professional basis and is going to work only if a beyond design-basis accident occurs. Headquarters of OEP consists of NPP high level managers. Emergency Preparedness Plan and Emergency Preparedness Operational Procedures were updated and put in force at Ignalina NPP taking into account the shutdown state of both Units.

3.1. Personnel Resources and Training

Personnel Resources

The Emergency Technical Service was established in frames of OEP. The Service office is temporarily staffed by the personnel of all NPP personnel on the professional basis and will work only if a beyond design-basis accident occurs. There are six brigades in Emergency Technical Service divided into groups and units:

- Brigade of Damage Repair at Nuclear Facilities consists of 56 persons in 5 groups and 12 units,
- Brigade of Emergency Recovery Works consists of 33 persons in 4 groups and 4 units,
- Brigade of I&C Equipment consists of 12 persons in 2 groups and 2 units.
- Brigade of Emergency Recovery Works on chemical equipment consists of 19 persons in 2 groups and 3 units,
- Brigade of Emergency Recovery Works on turbo-compressors, diesels, boiler-house equipment, pipe communications and transport facilities consists of 30 persons in 4 groups,
- Brigade of Emergency Recovery Works on electrical equipment consists of 55 persons in 2 groups and 6 units.

As an example, the structure of the Brigade of Damage Repair at Nuclear Facilities is presented in Figure 3.1-1.

Training and exercises

Director for Decommissioning, as an authorized person of the Director General, once per 5 years is trained at the civil protection training centre of the Fire and Rescue Department under the Ministry of the Interior according the civil protection training programme for the heads or the authorized persons of facilities included in the register of the state importance facilities and hazardous facilities.

The senior engineer, Fire Supervision and civil protection inspector, the Head of the Organization of Emergency Preparedness Headquarters, as well as the civil protection engineer of the Fire Supervision and Civil Protection Group (as the assistant of the Head of the Organization of Emergency Preparedness Headquarters) once per three years are trained at the civil protection training centre of the Fire and Rescue Department under the Ministry of the Interior according to the civil protection programme for the permanent members.

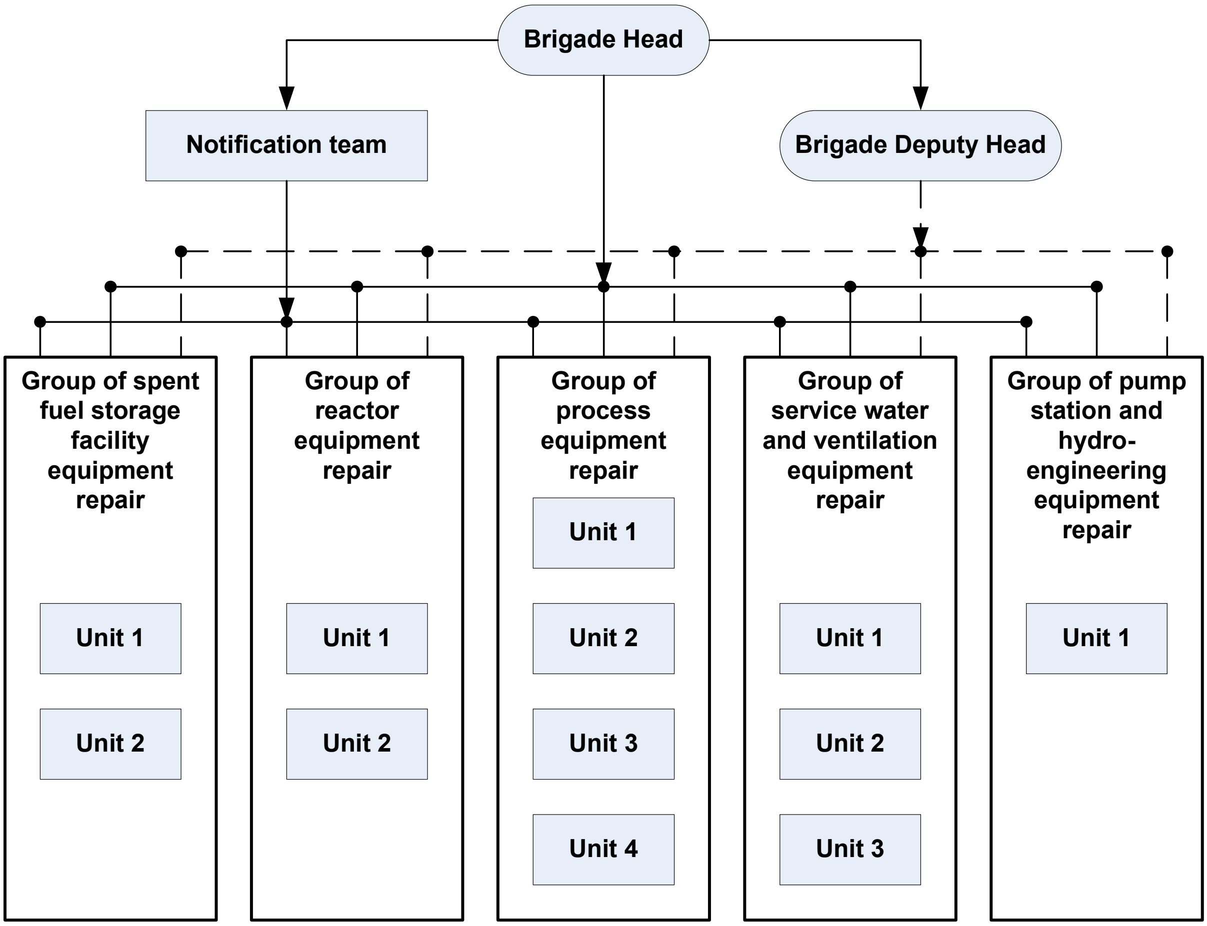

Figure 3.1-1. Structure of the Brigade of Damage Repair at Nuclear Facilities

Training of the personnel provides the initial training in the scope of requirements to the position at the employment, and development of the practical skills during trainings and exercises.

The Head of the Fire Supervision and Civil Protection Group gives annual classes in the educational groups of the OEP top management:

- the schedule includes educational themes on PEP, actual issues of emergency preparedness and civil protection in the concrete educational year, as well as recommendations of VATESI and of the Fire and Rescue Department under the Ministry of the Interior;
- not less than once per year the Head of the Fire Supervision and Civil Protection Group organizes and conducts group exercises with the Heads of the Organization of Emergency Preparedness Headquarters.

The civil protection engineer of the Fire Supervision and Civil Protection Group conducts classes with group No 3, which includes the heads of the Ignalina NPP subdivisions, which are not members of the Organization of Emergency Preparedness.

The Heads of the OEP brigades and groups are responsible for development of the training programmes according to the Plan of Emergency Preparedness activities and agreement of these programmes with the Head of the Fire Supervision and Civil Protection Group. The Heads of the units and groups are responsible for organization of training of the subordinated personnel, as well as for preparation and implementation of functional trainings.

The assistant of the Head of the OEP Headquarters together with the Heads of the OEP Services organize functional trainings in the services. Functional trainings are assessed by the Head of the OEP Headquarters and his assistant.

Not less than once per three years Ignalina NPP Director General organizes complex training of the Organization of Emergency Preparedness.

Conclusion on the adequacy of the personnel resources and training for accident management

Organization and arrangements of the Licensee to manage accidents are adequate. No plans for additional strengthening the site organisation for accident management are needed.

3.2. Adequacy of Procedures

Mitigation of beyond design basis accident consequences is reached by accident management and/or by fulfilment of plans of personnel and population protection if the accident manages is impossible or ineffective.

Ignalina NPP five instructions and manuals are part of procedures intended to manage beyond design basis accidents:

- Instruction for user of procedures to manage beyond design basis accidents;
- Manual on manage of beyond design basis accidents RUZA-R1. Cooling of Ignalina NPP Unit 2 reactor;
- Manual on manage of beyond design basis accidents RUZA-RB. Decreasing of release of fission products from Ignalina NPP Units 1, 2;
- Manual on manage of beyond design basis accidents RUZA-B. Manage of state of Ignalina NPP Units 1, 2 spent fuel pools;
- Instruction on emergency cooling of Unit 2 reactor under total loss of Ignalina NPP service power supply.

The listed instructions and manuals contain a description of 10 strategies to manage beyond design basis accidents:

- Strategy C2 – water supply to MCC;
- Strategy C4 – elimination of MCC leakage;
- Strategy C7 – restoration of ALS cooling;
- Strategy C8 – ALS ventilation;
- Strategy C14 – isolation of Unit damaged rooms;
- Strategy C15 – feeding of water via fire cocks;
- Strategy C17 – feeding of water to spent fuel pools;
- Strategy C18 – elimination of spent fuel pool leakage;
- Strategy C19 – supply of neutron absorber into spent fuel pools;
- Strategy C20 – isolation of damaged spent fuel pool from other pools.

Manuals on management of beyond design basis accidents RUZA have the priority against all other procedures and instructions. During execution of RUZA procedures, actions are allowed, which are not allowed during normal operation, such as cut off of protection functions and interlocks, obvious damage of minor equipment, limited release of radioactive products in the environment etc.

Conclusion on the adequacy of procedures for manage of beyond design basis accidents

Manuals on management of beyond design basis accidents are adopted for current state of Ignalina NPP. There are foreseen strategies for management of beyond design basis accidents in reactor, including spent fuel pools. Manuals on management of beyond design basis accidents are part of Emergency Preparedness Operational Procedures of Emergency Preparedness Plan and are updating periodically.

As a result of “stress tests” carried out, some measures related with the improvements of the procedures for manage of beyond design basis accidents are mentioned in Chapter 1 and Chapter 2.

No plans for additional improvement of the procedures for management of beyond design basis accidents are needed.

3.3. Multi-Unit Events

OEP responsibilities, which cover Unit 1 and Unit 2, are the same for both units of Ignalina NPP. OEP of Ignalina NPP has enough manning level and technical resources to cope with accidents in any nuclear facilities situated on-site of Ignalina NPP. The highly qualified and especially trained personnel are included in the OEP. Besides, additional personnel may be involved to deal with extended accidents.

Conclusion on the adequacy of severe accident management and recovery in case of multi-unit events

Organization and arrangements of the Licensee to manage severe accidents in case of multi-units events are adequate. No plans for additional strengthening the site organisation for accident management in case of multi-units events are needed.

3.4. Equipment Availability

Management of severe accidents

OEP Accident Management Centre and Technical Support Centre are created and equipped at Ignalina NPP. There are all needed systems, equipment, devices, tools and materials to support the accident management. Equipment necessary for implementation of strategies described in RUZA is preassembled and stored in special assigned places. There are envisaged all needed measures for modification of design and trained personnel for implementation of those strategies.

Provisions to use mobile devices

Two mobile diesel generators are available at Ignalina NPP in case of SBO. Time to bring them to the pre-installed connection points and put in operation is about one hour.

There are available heavy equipment (the tractors, automobile cranes, trucks, pumps installations, pneumatic tools) and other technique and means for carrying out the emergency removal and repair works coordinated by OEP for beyond design-basis emergency.

Management of radioactive releases, provisions to limit them

The Ignalina NPP possesses all the required resources and technical facilities for monitoring and mitigation of radioactive releases consequences caused by beyond design-basis accidents.

OEP have the possibility to use the radiation safety monitoring system of Ignalina NPP, which includes:

- the monitoring system of discharges into the ventilation stack;
- the automated radiation safety monitoring system (monitoring of radiation condition inside the power plant);
- the automated radiation monitoring system (monitoring of discharges, drains, radiation condition in the district using the stationary posts, also monitoring of gamma-background in 30 km area).

In additional, there is Radiation Protection Department established in frame of OEP, which staffed by the personnel of NPP and includes special on-site and off-site reconnaissance groups, individual dosimetric control group, personnel and transport deactivation groups.

For assessment of off-site radiation consequences of the accident, the hardware and software of the computer system “NOSTRADAMUS” is used. This system is intended for operative forecasting of the radiation situation caused by the discharge of radioactive materials during the accident. The Ignalina NPP surroundings map is presented in Figure 3.4-1 with the plotted lines of the level of the district radioactive contamination from the radioactive emissions. Figure 3.4-1 was obtained during the OEP exercises of system “NOSTRADAMUS”.

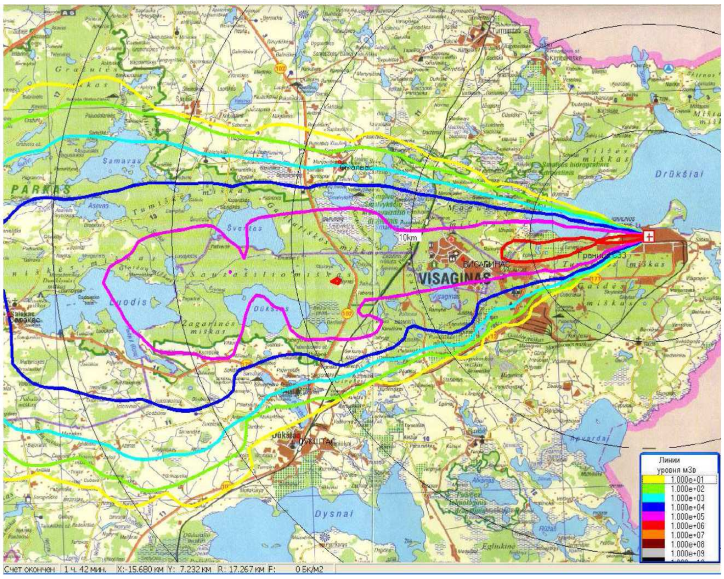

Figure 3.4-1. The Ignalina NPP surroundings map with the plotted lines of the level of the district radioactive contamination caused by the radioactive emission

Communication and information systems

Organization of Emergency Preparedness has the Accident Management Centre (AMC) in the administrative building equipped with all required facilities for accident management and communication. Besides, there is the special room for the OEP Technical Support Centre (TSC), which also has everything required for the work of the experts. There are diverse communication facilities at Ignalina NPP: stationary telephone, cell phone, speakerphone, and radio communication. Communication facilities ensure the reliable communication between any key points of the NPP such as MCR, ECR, Central Electric Control Room, AMC, TSC, Information Centre, local control points and many others. There is the internal announcement system used loud-speakers connected with the MCR and AMC.

In case of SBO the AMC can be powered by the independent stationary diesel generator, which is installed in the AMC auxiliary room. As well the lighting, communication facilities and computer information system of AMC can be powered by the mobile diesel generator using pre-installed connection point on the wall of administrative building.

Along with the internal communication, the MCR and AMC operators have the possibility to communicate with external institutions such as government, regulator, local municipalities, energy system dispatchers, mass media etc. External communications are provided with few redundant communication lines.

Conclusion on the adequacy of available equipment for manage and monitoring of beyond design basis accidents and their consequences

Equipment, tools and organizational measures of Ignalina NPP available for manage and monitoring of beyond design basis accidents and their consequences are adequate. No plans for additional strengthening of the technical and organizational measures in this field are needed.

Part II

4. National Organizations

4.1. Regulation of Nuclear Energy Sector

The main legal acts defining responsibilities of state institutions in nuclear energy, as well as in nuclear security, radiation protection and emergency preparedness, is Law on Nuclear Energy of the Republic of Lithuania [22].

There are 7 ministries directly or via its subordinated institutions involved in Lithuania's nuclear energy sector regulation. These ministries and some other institutions are shown in Fig. 4.1-1.

The Ministry of Energy is the principal institution coordinating and responsible for the development of nuclear power. The Ministry of Energy is also the essential policy shaping and decision making body in the sector.

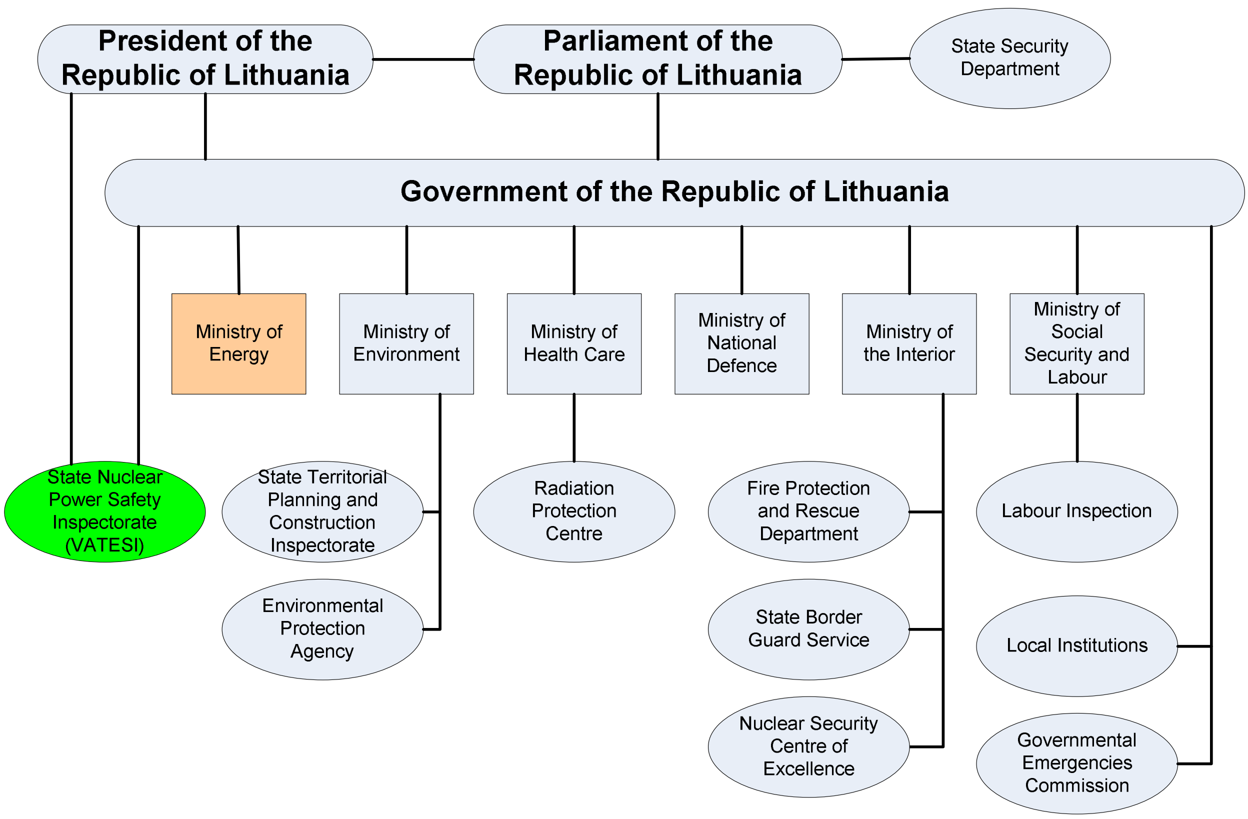

Figure 4.1-1. Lithuanian governmental structure for regulation of nuclear energy sector

4.2. Nuclear Safety Regulator

The State Nuclear Power Safety Inspectorate (VATESI) is the main regulatory and supervisory institution for nuclear power safety. VATESI is a governmental institution, established in 1991. Responsibilities and duties of VATESI are described in Law on Nuclear Energy of the Republic of Lithuania [22] and Law on Nuclear Safety of the Republic of Lithuania [23].

The Head of VATESI for a term of six years is appointed by the President of the Republic of Lithuania on the proposal of the Prime Minister. The Head of VATESI is directly accountable to the President of the Republic of Lithuania and to the Government.

According to Law on Nuclear Energy of the Republic of Lithuania the Head and Deputy Heads of VATESI in their official capacity shall act independently from the persons engaged in activities in the field of the nuclear energy sector, also from other agencies, institutions or organisations engaged in expansion of the nuclear energy or use of nuclear energy, including generation of electricity.

VATESI mission is to perform the state regulation and supervision of safety at nuclear facilities in order to protect the public and environment against harmful effects of nuclear and radiation events and accidents.

VATESI organizational structure is presented in Figure 4.2-1.

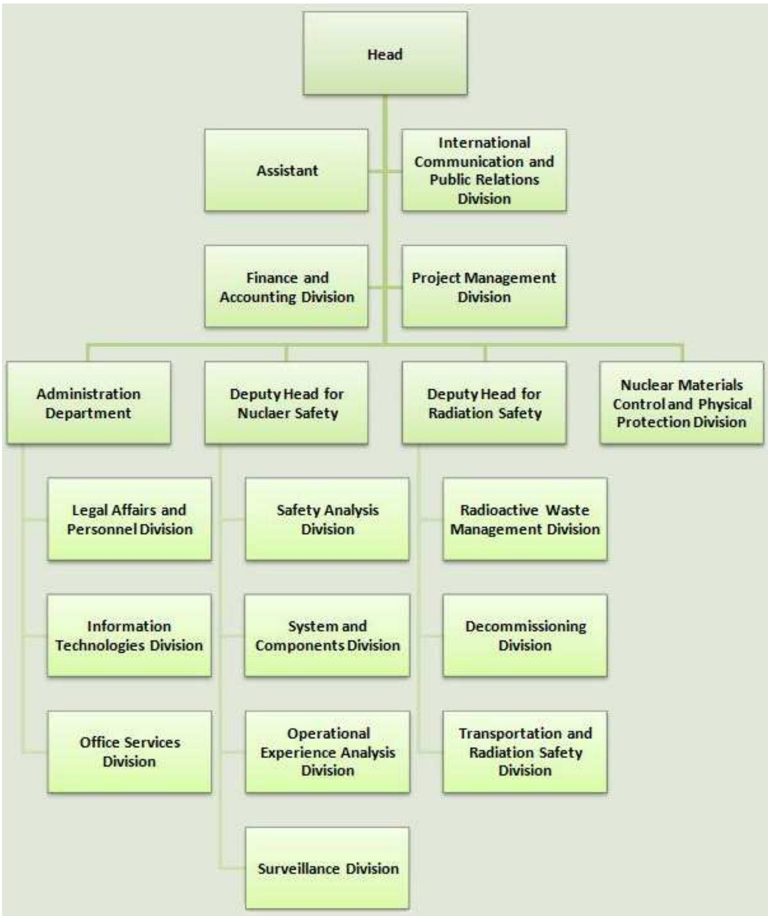

Figure 4.2-1. VATESI organizational structure

VATESI sets safety requirements, controls whether they are complied with at nuclear facilities, other companies and organizations involved in nuclear activity and/or nuclear fuel cycle materials, issues licences and permits, apply enforcement measures, performs safety assessments and other functions. VATESI is entitled to suspend or even to terminate operation of a nuclear facility if flagrant non-compliance with requirements is established.

Nuclear safety assurance includes main priorities for VATESI such as:

- Safe maintenance of safety important structures, systems and components of Ignalina NPP;
- Safe decommissioning of Ignalina NPP;
- Construction, commissioning and safe operation of radioactive waste management facilities;
- Preparation for the licensing and supervision of the new Visaginas NPP.

To assure round-the-clock communication with the emergency preparedness authorities of the Republic of Lithuania and international organizations, VATESI has appointed early notification officers who at any time of the day and night are ready to receive or to provide information about any nuclear or radiological accident that has occurred in Lithuania or other countries. At any time, upon the receipt of a notification about a nuclear accident in Lithuania or any other country, VATESI Emergency Centre is ready no later than within one hour to start its operations, if the accident is likely to cause a threat to the people in Lithuania.

One of the priority goals at VATESI is highly qualified and having special knowledge personnel. For Lithuania the significance of this goal has been increasing after having made the decision to construct the new nuclear power plant and due to the targeted goal to get properly prepared for licensing of the new nuclear power plant and supervision over its safety. VATESI pays major attention to the training and qualification improvement of its employees. Measures for training of inspectors (in-service training, training courses) are envisaged in the IAEA National Project "Strengthening the nuclear safety regulatory authority and other institutions in the licensing of a new NPP".

The IAEA Integrated Regulatory Review Service (IRRS) mission in VATESI is planned in 2016. The preparation for the missions is going in current time.

4.3. Owners and Operators of nuclear installations

The Ignalina NPP owner is the State represented by the Ministry of Energy of Republic of Lithuania. The Ignalina NPP operator is the State Enterprise "Ignalina Nuclear Power Plant".

Visagino atominė elektrinė, UAB established in 2008, is implementing preparatory works (Environmental Impact Assessment, site evaluation and others) of the new Visaginas NPP project. The future operator (license holder) of Visaginas NPP is going to be established after the Shareholder agreement among the parties participating in the project would be signed.

4.4. Technical Support Organizations

Technical support organisations (TSO) help both operating organisations and regulatory institutions to ensure safety of nuclear installations or facilities. The same TSO cannot at the same time support both the operating organization and regulatory institutions concerning the same safety issues. Main Lithuanian institutes and universities , involved as TSOs: Lithuanian Energy Institute, Kaunas Technological University , Institute of Physic, Vilnius Gediminas Technical University. Assistance of foreign experts is also used in implementing safety objectives.

4.5. Conclusions

No specific actions are needed to improve independence of nuclear regulatory body as sufficient independence is already foreseen in existing laws.

5. Off-Site Emergency Preparedness and Post-Accident Management

5.1. Crisis Management

Crisis management in Lithuania is arranged at few levels: State, institutions such as VATESI Emergency Centre, municipalities, and NPP operator.

Legislative and normative documents are provided at the State level involving Parliament and Government of Republic of Lithuania. Detailed responsibilities and functions of all institutions are defined in the National Emergency Management Plan approved by Government decision No. 1503, on October 20, 2010, and in the National Plan for Protection of Population in case of Nuclear Emergency approved by Government decision No. 99, on January18, 2012.

National Plan for Protection of Population in case of Nuclear Emergency defines civil protection actions in case of nuclear accident in Lithuania and/or outside of Lithuania. The general objectives of emergency planning are to prevent serious deterministic health effects and to reduce the likely stochastic health effects of ionising radiation. This plan provides means of protecting the population, their scope, terms, assignment of responsibilities, and implementation procedure. The plan organises and co-ordinates actions taken over by ministries, other state institutions, municipal authorities for taking protective measures, for arrangement of immediate response actions, for the operative notification of neighbouring countries, EC, IAEA, etc. The Plan is prepared in accordance with IAEA Requirements GS-R-2 ,,Preparedness and Response for a Nuclear or Radiological emergency" and IAEA Safety Guide GS-G-2.1 ,,Arrangements for Preparedness for a Nuclear or Radiological Emergency".

The radiological evaluation, effective decision-making and coordination of activities of different subdivisions during crisis situations, collection and timely distribution of reliable information have to be provided by state institutions: VATESI, Ministry of Energy, Ministry of Environment, Radiation Protection Centre under the Ministry of Health Care, Fire Protection and Rescue Department of the Ministry of the Interior, and others.

Rescue operations have to be carried out by specially assigned departments of the Ministry of the Interior and, if needed, by military units of the Ministry of National Defence.

Control and management of contaminated food shall be provided by the Ministry of Agriculture and Ministry of Health.

Evacuation of population, if needed, is responsibility of Ministry of Transport and Communication, Ministry of the Interior and local institutions (municipalities).

Post-accident recovery activities have to be organized by the Ministry of Economy and carried out by designated companies.

The need, amount and source of indemnifications have to be determined by the Government of Republic of Lithuania.

Municipalities have to organize local works such as road recovery, medical service, decontamination works etc. in case of nuclear accident. As well municipalities have to participate in evacuation activities if needed.

Those institutions have developed procedures and instructions for different accident scenarios. Some institutions have special Emergency Response Centres, mobile rescue parties, fire brigades, equipped with all necessary tools, heavy equipment, vehicles etc. Interdepartmental commissions, working groups or/and temporary subdivisions can be established if needed.

Overview of crisis management at the level of the NPP operator is presented in Chapter 3 of Part I.

5.2. Emergency Preparedness and Response

The main legal act regulating principles and criteria of emergency preparedness actions is Hygiene Standard HN 99:2011 „Protective Actions of Public in Case of Radiological or Nuclear Emergency". Hygiene Standard HN 99:2011 has been adopted by the Order of the Minister of Health on December 7, 2011 (supersedes HN 99:2000) and it is supervised by Radiation Protection Centre. This document implements IAEA General Safety Guide GSG-2 „Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency". Hygiene Standard HN 99:2011 is a basis for the National Plan for Protection of Population in case of Nuclear Emergency.

Nuclear utilities have to implement their emergency preparedness plans according to VATESI regulation P-2008-01 "The requirements for emergency preparedness to the organization operating the nuclear installation". The organizations are responsible for emergency preparedness on-site as well as in exclusion zone. The nuclear facility itself must have properties ensuring that the effects of ionizing radiation on the population and the environment do not exceed the set limits both during normal operation and in the case of an accident.

Lithuania has the national Emergency Response Centre under the Ministry of the Interior, as well as the Fire Safety and Rescue Department of this ministry.

Emergency Response Centre is established in VATESI as well. The specialists of the VATESI Emergency Response Centre participate in international emergency preparedness exercises, international communication tests and VATESI communication tests.

There is an emergency warning system in each settlement, inhabited locality in Lithuania. Radio, television, loud-speakers and hazard sirens are used in the warning systems. Loud-speakers and hazard sirens are periodically tested.

With the intention to address the lessons learned from the nuclear emergency following the East-Japan earthquake and tsunami, the IAEA Board of Governors adopted the Action Plan on Nuclear Safety, which encourages Member States to review their emergency preparedness capabilities and to invite corresponding review services offered by the IAEA. In beginning of 2012, the Ministry of Energy of the Republic of Lithuania submitted a request for an Emergency Preparedness Review (EPREV) mission to assess the prevailing situation in the country, with special regard to the country's declared intention to embark on the use of nuclear energy. EPREV is a service the IAEA offers to assess a country's nuclear and radiological emergency preparedness arrangements vis-à-vis the relevant international standards. The EPREV mission in Lithuania was implemented from 1 to 11 October 2012.

The overall objectives of EPREV mission were:

- To provide an assessment of the Lithuania arrangements and capabilities to respond to nuclear or radiological emergencies regardless of the cause.
- To assess the condition in which the Lithuania resides with regard to international standards for emergency preparedness and response.
- To assist the Lithuanian in the development of interim arrangements to promptly respond to a nuclear or radiological emergency. This will include suggested steps that can be taken immediately to better use existing capabilities.
- To assist the Lithuania in providing a basis upon which it can develop a longer term programme to enhance its ability to respond. This would include recommendations in the areas of arrangements, decrees, equipment, staff, and related functional areas.

The review focused on Lithuania's ability to respond to a nuclear or radiological emergency and was based on an assessment of existing response provisions and capabilities. The EPREV mission was carried out in accordance with the guidelines developed for the EPREV services (EPREV Guidelines).

The EPREV review mission was designed to cover all aspects of the arrangements for emergency preparedness and response and included: on-site (facilities), off-site, local and national emergency response and preparedness arrangements for all radiation emergencies that may affect Lithuania.

At the end of mission EPREV experts prepared draft report "Peer appraisal of the arrangements in Lithuania regarding the preparedness for responding to a radiation emergency". In this report the EPREV mission experts has formulated recommendations and suggestions, as well as the observations of good practices. Final report should be confirmed in the end of 2012 or beginning of 2013.

After confirming of final report all Lithuanian institutions involved in this review should address recommendations and suggestions following from this report and to develop the measures of improvements if necessary.

5.3. Communications

Reliable communication is an important part of the Lithuanian emergency preparedness and post-accident management.

All institutions involved in the emergency preparedness and post-accident management are provided with at least 3 different means of communication between each other and with Ignalina NPP Main Control Room, Accident Management Centre, Technical Support Centre, and Information Centre. Communication systems used at Ignalina NPP are described in 3.4 above.

Communications with local municipalities, energy system dispatchers, mass media, State institutions of neighboring countries, international organizations etc. are provided as well.

5.4. Transparency/Openness

All important information concerning severe accident including at least the actual and forecasted radiation situation in different areas of Lithuania, the discharge of radioactive materials during the accident, food contamination, evacuation information, etc. has to be widely provided to the population using television, radio, Internet and other mass media.

Lithuanian Government, VATESI, Crisis Management and Emergency Response institutions, local municipalities, energy system dispatchers, mass media, governmental institutions of neighbouring countries and international organizations concerned with nuclear safety have to be provided with competent and correct information by Ignalina NPP designated staff and by VATESI authorised official in maximum possible details and as soon as possible.

Round-the-clock operating (during a severe accident) official on duty of VATESI Emergency Response Centre should answer questions concerning the accident; if he has insufficient information, he is bound to obtain the needed information from NPP or other sources.

5.5. Conclusions

1. No specific actions are needed to improve independence of nuclear regulatory body as sufficient independence is already foreseen in existing laws.
2. Activities raised from EPREV review mission conducted in Lithuania regarding the preparedness for responding to a nuclear or radiological emergency should be addressed and included in the Plan if necessary. This updating of the Plan is planned to be completed in 2013.

6. International Cooperation

6.1. Conventions

Lithuania fully shares the position that nuclear power plant accident in Japan has revealed the need to strengthen the international legal framework of nuclear safety. Lithuania is of the position that legally binding international nuclear safety standards should be adopted. This position was officially expressed in the Fifth Review Meeting of the Contracting Parties of the CNS in April 2011, IAEA High Level Meeting in June 2011, IAEA General Conference in September 2011, Meeting of the Contracting Parties of the Espoo Convention in June 2011, UN High-level Meeting on Nuclear Safety and Security (September 2011), EU Council meetings, Seoul Nuclear Security Summit (March 2012), etc.

Convention on Nuclear Safety (CNS)

Convention on Nuclear Safety is a very important document in regard to nuclear safety, though this international instrument needs to be revised and adapted to new challenges raised by Fukushima accident. Nevertheless, even current provisions laid down in the CNS should be fully implemented.

Lithuanian position in regard to implementing the current provisions as well as the need for strengthening the CNS was clearly expressed during the Fifth Review Meeting of the Contracting Parties on 4-14 April 2011. Due to Lithuanian and other countries' efforts the final document of the Meeting included such important aspects as the need for contracting parties to make a final decision on new NPP site selection only in close cooperation with neighbour countries, need to evaluate potential sites for new NPPs in accordance with IAEA safety standards; need to properly inform society about nuclear energy development. Lithuanian position to strengthen CNS was also expressed in other IAEA, EU, UN high level events.

Lithuania also supports and actively participates in the EU level talks and coordination of positions in regard to the CNS review process.

Espoo Convention

United Nations Convention on Environmental Impact Assessment in a Transboundary Context (thereinafter – Espoo Convention) is the main international document which regulates, inter alia, environmental impact assessment process (thereinafter – EIA) for new nuclear power plants.

Even before the Fukushima accident, Lithuania fully implemented the Espoo Convention while implementing new NPP project in Visaginas. Also, Lithuania before and after Fukushima disaster is actively participating in the EIA processes of the NPPs in the neighbouring states: Belarus and Russian Federation. Also Lithuania expressed the willingness to participate in the EIA process of the planned NPP in Poland.

Convention on Early Notification of a Nuclear Accident

Following recommendations set in the Convention on Early notification of a Nuclear Accident, Lithuania has signed two bilateral agreements with neighbouring countries (Latvia, Poland) and three bilateral agreements with Scandinavian countries: Denmark [20], Norway [18], Sweden [21].

Agreements with Latvia [17] and Poland [19] cover early notification and direct exchange of information between State Nuclear Power Safety Inspectorate (Lithuania) and Radiation Safety Centre (Latvia) and Radiation Emergency Center CEZAR (Poland) in case of nuclear or radiological accidents. Agreements also cover the exchange of information on nuclear safety of nuclear facilities in operation as well as those being planned or under construction, their commissioning and decommissioning. Scientific and technical cooperation in the field of nuclear safety and radiation protection, including monitoring of radioactive releases, emergency planning and management of spent nuclear fuel and radioactive waste are also covered by agreements.

6.2. Arrangements with International Organizations

IAEA

Lithuania fully supports the IAEA efforts in regard to nuclear safety and preparation of the Nuclear Safety Action Plan. Lithuania supported and actively participated in the process of preparation of this Action Plan in the EU level as well as by submitting direct proposals to the IAEA. In this regard, official proposals for the Action Plan were submitted to the IAEA in August 2011 (to strengthen IAEA safety standards and IAEA role in nuclear safety area; in case of dispute conduct IAEA specialized missions before the final decision on NPP site is made; need to strengthen national nuclear regulatory authorities; enhance publicity about IAEA missions etc.). Lithuania is of the position that IAEA should play a key role in order to enhance nuclear safety worldwide.

EU

After the accident at Fukushima-Daiichi nuclear power plant in Japan, the European Council in the conclusions of its meeting of 24-25 March 2011 stated that the safety of all EU nuclear plants should be reviewed, on the basis of a comprehensive and transparent risk and safety assessment (stress-tests). Lithuania from the initial phase of this initiative was of the position that stress tests under the EU methodology should be performed not only in the EU member states but also in the neighbouring countries for existing and planned NPPs. This view was reflected in the EU Council conclusions of 24-25 March 2011 as well as 9 December 2011. Lithuania itself fully participated in the stress tests activity. Lithuania also welcomed the declaration of 23 June 2011 on stress-tests between representatives of European Commission, Republic of Armenia, Republic of Belarus, Republic of Croatia, Russian Federation, Swiss Confederation, Republic of Turkey and Ukraine. Lithuania looks forward to all indicated countries to complete their declared activities.

Other international efforts to enhance nuclear safety and security

In September 2011 Lithuania actively participated in the initiative by United Nations Secretary General Ban Ki-moon to organise a High Level Meeting on Nuclear Safety and Security in response to the disaster at the Fukushima NPP. Lithuania, during this event, put an emphasis on the necessity to finally learn the lessons of previous nuclear accidents and respect for all nuclear safety related conventions, IAEA standards and recommendations.

In March 2012 Nuclear Security Summit in Seoul, Lithuania put an emphasis on the necessity to implement IAEA Nuclear Safety Action Plan, also, stressed the need to strengthen and review international nuclear safety standards and international conventions. Promotion of synergy between nuclear safety and security, international consultations and transparency was also mentioned as of key importance. During the Summit Lithuania has officially announced about the establishment of national Nuclear Security Centre of Excellence. IAEA Director General Y. Amano officially supported this initiative.

All available information related with Fukushima accident and post-accident is being analysed by Lithuanian experts in order to determine proper nuclear safety requirements and appropriate safety measures. Existing IAEA working groups, such as Commission of Safety Standards, Nuclear Safety Standards Committee, appropriate WENRA working groups, where VATESI is participating, are useful platform to share gained experience in different countries. This type of cooperation is planned to continue in the future. Also VATESI has periodic meetings with US NRC as well as with Japan nuclear regulatory authority where Fukushima post-accident issues are discussed. Additional to those, regular consultations between VATESI and Visagino atominė elektrinė, UAB (this company is implementing preparatory works of Visaginas NPP construction project) are ongoing, where possible ABWR design improvements are discussed taking into account lessons learned from Fukushima event. ABWR technology provider – Hitachi-GE Nuclear Energy – participates in these consultations as well.

6.3. Sharing Operating Experience

The use of internal and external operational experience in Lithuania is regulated by the VATESI Requirements on the Operational Experience Feedback in the field of Nuclear Energy. According to these Requirements the Licensee shall systematically collect, analyze and disseminate his own operational experience along with the operational experience of other persons operating in the field of nuclear energy with an aim to prevent accidents, safety important events, to avoid their recurrence, to assure and further improve safety in the field of nuclear energy.

VATESI has established a permanent Commission of Unusual Events and Operational Experience (hereinafter – the “Commission”), which analyses Licensees prepared reports on unusual events at Ignalina NPP and other nuclear facilities (NF) in Lithuania and abroad. The main sources of external operational experience are IAEA/NEA IRS and FINAS databases. As a result of operational experience analysis, performed by the Commission, recommendations related to the improvement of safety and lessons learned in other NF are handed over to Ignalina NPP and are used for improvement of VATESI regulations, particularly related with the construction of nuclear power plant. The results on external operational experience usage in Lithuania and operational experience gained during Ignalina NPP operation and preparation for decommissioning is shared through IAEA/NEA IRS database as well as during the IAEA workshops.

VATESI is a member of the European Network on Operational Experience Feedback for Nuclear Power Plants (hereinafter – the "EU Clearinghouse"). The overall objectives of the Clearinghouse are to facilitate efficient sharing and implementation of operational experience feedback to improve the safety of nuclear power plants. Following the accident in Fukushima the EU Clearinghouse provided its members with the summaries and updates of the accident development, radiation monitoring data and countermeasures taken. This information together with received from other sources was used by VATESI Emergency Center.

The main requirements for reporting of unusual events occurred at Ignalina NPP are established in VATESI Requirements for Reporting of Events at NPPs. Ignalina NPP has established an Operational experience feedback group to coordinate the internal and external operational experience usage. The operational experience is shared over all departments and assures the effective operational experience feedback from different departments of the plant.

Since permanent shutdown of the first (2004) and second (2009) units of the Ignalina NPP, Lithuania is implementing radioactive waste management projects, linked to decommissioning. All international conventions (Convention on Nuclear Safety, Espoo Convention, etc.) are followed in these projects.

Ignalina NPP is a member of WANO. The plant prepares and submits to WANO reports on events occurred at Ignalina NPP and the operational experience gained from WANO is used at Ignalina NPP to improve safety at the decommissioning stage.

6.4. Application of the IAEA Safety Standards

There are some examples in Table 6.5-1 below demonstrating using of IAEA safety standards as a base for developing of National nuclear energy safety legislation.

Table 6.4-1. Application of the IAEA safety standards in national nuclear energy safety legislation

	National legislation	Responsible institution	IAEA Safety Standards
1.	Law on Nuclear Safety, 2011	Parliament	Fundamental Safety Principles, SF-1, 2006.
2.	Requirements for Management Systems, 2010	VATESI	Safety Requirements: The Management System for Facilities and Activities, GS-R-3, 2006. Safety Guide: Application of the Management System for Facilities and Activities, GS-G-3.1, 2006. Safety Guide: The Management System for Nuclear Installations, GS-G-3.5, 2009.
3.	Preparation and Use of the Nuclear Power Plant's	VATESI	Safety Guide: Format and Content of the Safety Analysis Report for Nuclear Power Plants, GS-G-4.1, 2004.

	National legislation	Responsible institution	IAEA Safety Standards
	Safety Analysis Report, 2011		
4.	General Requirements for the Site Evaluation of Nuclear Power Plant, 2010	VATESI	Safety Requirements: Site Evaluation for Nuclear Installations, NS-R-3, 2003.
5.	The Design of the Nuclear Power Plant (under preparation)	VATESI	Design Specific Safety Requirements: Safety of Nuclear Power Plants**,** SSR-2/1, 2012.
6.	Operation of the Nuclear Power Plant (under preparation)	VATESI	Commissioning and Operation Specific Safety Requirements: Safety of Nuclear Power Plants, SSR-2/2, 2011.
7.	Safety Assessment of Nuclear Facilities and Activities in the Nuclear Energy Sector (under preparation)	VATESI	General Safety Requirements: Safety Assessment for Facilities and Activities, GSR Part 4, 2009.
8.	Commissioning of the Nuclear Power Plant (under preparation)	VATESI	Commissioning and Operation Specific Safety Requirements: Safety of Nuclear Power Plants, SSR-2/2, 2011. Safety Guide: Commissioning for Nuclear Power Plants, NS-G-2.9, 2003.
9.	Probabilistic Safety Assessment (under preparation)	VATESI	Specific Safety Guide: Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants, SSG-3, 2010. Specific Safety Guide: Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants, SSG-4, 2010.
10.	Design, Installation and Operation of the Reactor's Cooling Systems at the Nuclear Power Plant (under preparation)	VATESI	Safety Guide: Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants, NS-G-1.9, 2004.
11.	Design, Installation and Operation of the Nuclear Power Plant's Containment (under preparation)	VATESI	Safety Guide: Design of Reactor Containment Systems for Nuclear Power Plants, NS-G-1.10, 2004.

6.5. Conclusions

Lithuania is a responsible member of international community and seeks to enhance international cooperation worldwide on implementation of all IAEA nuclear safety standards, principles and international conventions during the whole NPP life cycle. Lithuania also in IAEA, UN and other levels raised an initiative to apply "5S" rule (safe technology in the safe site under safe construction, safe operation and safe decommissioning) for all nuclear energy projects worldwide. National nuclear energy safety legislation is based on IAEA safety standards and this strategy will be used and maintained in the future.

Part III

7. Safety of New NPP

Initial causes of Fukushima Daiichi nuclear power plant accident show the importance of comprehensive evaluation of external factors that may influence the nuclear power plant. This evaluation shall be done starting from the earliest life cycle stages of new nuclear power plants. The measures to eliminate or mitigate the risks that those factors pose in the design of the nuclear power plant shall be examined during designing. Fukushima lessons would be taken into account with reference to the planned new Visaginas NPP.

ABWR type reactor, designed by Hitachi-GE Nuclear Energy, Ltd is proposed for Visaginas NPP. Currently Visaginas NPP site evaluation report is under review and assessment.

Two potential sites for construction of Visaginas NPP are selected and evaluated in detail taking into account the requirements of Law on Nuclear Safety of the Republic of Lithuania [23], VATESI requirements [24] and requirements of International Atomic Energy Agency [25] – [31]. It also should be noted that during the evaluation process the latest IAEA draft requirements such as DS417 Meteorological and Hydrological Hazards in Site Evaluation and a draft that later became a document SSG-9, Seismic Hazards in Site Evaluation for Nuclear Installations, were taken into account.

A detailed and comprehensive list of events that might influence safety of nuclear power plant on proposed sites has been established. The list was used to select sites specific events for which an evaluation has been done in very detail. Sites were evaluated in respect of external human induced events (both malicious and non-malicious), dispersion of radioactive material in air and water and consideration of population distribution, seismic hazards, meteorological events, flood hazard and geotechnical aspects and foundations. Moreover, these evaluations are supplemented by additional considerations such as: evaluation of site characteristics that might influence the implementation of physical protection measures, evaluation of site characteristics that might influence the implementation of civil protection measures and evaluation of the reliability of the Drūkšiai Lake as an ultimate heat sink.

Possibilities for emergency planning were evaluated. In the course of evaluation site characteristics that might impact the emergency planning were identified and corresponding countermeasures were proposed.

Evaluation of Ultimate Heat Sink characteristics has been performed. Drūkšiai Lake was evaluated as an ultimate heat sink for NPP. Characteristics of the ultimate heat sink that might impact the safety of the NPP have been identified and corresponding countermeasures proposed.

Visagino atominė elektrinė, UAB prepared Site Evaluation Report (SER), where results of the performed evaluations are provided. The results show that both selected sites are Type 2 sites (according to IAEA classification). Probabilistic and deterministic seismic hazard assessments confirmed that both sites are undergoing low seismic activity. It was concluded that both sites are suitable for construction of new nuclear power plant. There is a list of hazards and site specific conditions that have to be accounted in the design of Visaginas NPP.

SER was independently reviewed and verified by Paul C. Rizzo Associates, Inc (USA).

The IAEA Site Safety Review Mission (SSRM) for Visaginas NPP was requested by VATESI, under the framework of the IAEA Technical Co-operation national project LIT/9/009 “Enhancing VATESI and other institutions in licensing of new NPPs”, and took place on 8-12 November 2010. SSRM reviewed the SER, and the report of the mission was finalized at the end of March 2011. IAEA experts stated that “Sites evaluation is conducted in line with IAEA requirements and guides, the volume of investigation is sufficient, and both sites are suitable for construction of Visaginas NPP”. IAEA SSRM provided some technical detailed comments and recommendations in order to improve compliance with IAEA safety guides, and majority of these recommendations have been already implemented. Visaginas NPP Site Evaluation Report is under review of appropriate State institutions. The final decision about suitability of the site for construction of new nuclear power plant is planned to be taken in the beginning of 2013.

Part IV

8. Implementation of the Plan

Activities and corresponding measures indentified in this report are approved by VATESI and provided in Table 8-1. below. Responsibilities among VATESI and Ignalina NPP for implementation of indentified measures, as well as status and dates of implementation of measures are provided in this Table. The Plan will be available trough the VATESI web site for public access and review.

Table 8-1. Summary of activities of the Plan

No.	Topic	Activity	Basis	Finalization	Status	Responsibility
1.	General	To consider the necessity of revision of the regulations applied to NPPs robustness against natural hazards (earthquake, flooding and extreme weather conditions), including revaluation of margins beyond the design basis and cliff-edge effects in compliance with planed WENRA guidance when it will be issued.	ENSREG Peer Review Report Planned WENRA guidance	1 year after issuing of WENRA guidance	Planned	VATESI
2.	General	Taking into account planned WENRA guidance (see topic above in this table) review and update, if necessary, of existing nuclear safety regulations applied to Visaginas NPP, as well as ones which are in preparation in the field of: o natural hazards assessment, including evaluation of margins beyond design basis and cliff-edge effects; o design and beyond design basis issues, including provisions for power supply robustness, measures to protect containment integrity, instrumentation and control equipment robustness , including spent fuel pools issues; o severe accident management, including provisions for organization and arrangements to manage severe accidents, hydrogen management issue, severe accident phenomena issues, and measures to restrict the radioactive releases;	ENSREG Peer Review Report, CNS, Planned WENRA guidance	2015	Planned	VATESI

No.	Topic	Activity	Basis	Finalization	Status	Responsibility
		o emergency preparedness and response, including consideration of multi-unit events including long term effects, consideration of natural disasters leading to loss of infrastructure, concepts to manage large volumes of contaminated water, revaluation of communication and announcement capabilities. All other requirements dedicated to Visaginas NPP that encompass other fields should be checked in the light of post-Fukushima lessons learned and proposal of update if necessary.				
3.	General	Activities raised from EPREV review mission conducted in Lithuania regarding the preparedness for responding to a nuclear or radiological emergency should be addressed and included in the Plan if necessary.	EPREV review mission report	2013	Planned*	State institutions involved in EPREV mission
4.	Natural hazards	To evaluate the spent fuel cask tip over in case of earthquake during transportation and to assess radiological impact on the environment, personnel and population.	National final report on “stress tests”	2013	In progress	Ignalina NPP
5.	Natural hazards	To consider the necessity of improvement of emergency preparedness procedures or updating those after confirmation of the calculation results of the spent fuel cask tip over during transportation.	National final report on “stress tests”	2014	In progress	Ignalina NPP
6.	Natural	To assess the robustness and availability of accident management	National final	2013	In progress	Ignalina NPP

No.	Topic	Activity	Basis	Finalization	Status	Responsibility
	hazards	centre of organization of emergency preparednness against an earthquake. If needed, to develop measures to improve the robustness of accident management centre.	report on “stress tests”			
7.	Natural hazards	To consider the possibility of the seismic alarm and monitoring system application for formalization of the emergency preparedness announcement criterion and to include this criterion in the operational manual of the seismic warning and monitoring system.	National final report on “stress tests”	2012	Implemented	Ignalina NPP
8.	Natural hazards	To provide data transfer of the seismic alarm and monitoring system to the computer information system of organization of emergency preparednness, i.e. to the accident management centre, technical support organization and radiation safety monitoring control room and to update corresponding procedures of organization of emergency preparednness.	National final report on “stress tests”	2012 – 2013	In progress	Ignalina NPP
9.	Natural hazards	To assess the possibilities of the emergency removal and repair works by organization of emergency preparednness for beyond design-basis emergency scenarios related to the level of earthquake above maximal calculated earthquake and resulting in the cracks or collapse of the construction structures of the operating spent fuel interim storage facility and new spent fuel interim storage facility, including casks blockage by debris, as well as cracks or collapse of the construction structures of the “hot cell” of the new spent fuel interim storage facility during the works with spent nuclear fuel in the “hot cell”.	National final report on “stress tests”	2012 – 2013	In progress	Ignalina NPP

No.	Topic	Activity	Basis	Finalization	Status	Responsibility
10.	Design issues	To provide the power supply of water temperature and level instruments in the storage pools of both units from disiel generator No. 7 of unit 2 or from the mobile diesel generator connected to Unit 2.	National final report on “stress tests”	2011	Implemented	Ignalina NPP
11.	Design issues	To provide the diesel fuel supply for assuring long-term operation of diesel generators. The contract on the supply of diesel fuel was made with fuel company in January 2012.	National final report on “stress tests”	2012	Implemented	Ignalina NPP
12.	Design issues	To evaluate the capacity for work of water temperature and level instrumentation in the spent fuel storage pools as well as radiation detectors in the spent fuel storage pools halls of both units in conditions of beyond design-basis accident. If needed, to develop the appropriate improvement measures.	National final report on “stress tests”	2012 – 2013	In progress	Ignalina NPP
13.	Design issues	The special sub-module of the plant computer information system will be developed to provide information about the water temperature and level measurements in spent fuel storage pools as well as radiation level in the spent fuel storage pools halls from both units during and after beyond design-basis accident. The data of water temperature and level measurements in the spent fuel storage pools as well as radiation level measurements in the spent fuel storage pools halls will be transferred to the computer information system of main control room, accident management centre of organization of emergency preparedness and VATESI. This activity is planned by Licensee in accordance with modification schedule, to be completed	National final report on “stress tests”	2013	In progress	Ignalina NPP

No.	Topic	Activity	Basis	Finalization	Status	Responsibility
		not later 2014.				
14.	General	To examine existing documents concerning the spent fuel storage pools safety. To review management procedures and manuals of beyond design-basis accidents in the spent fuel storage pools. To evaluate planned and implemented modifications related with the spent fuel storage pools safety. To determine additional measures if needed.	ENSREG Country Peer Review Report	2012 – 2013	In progress	Ignalina NPP

* The activities raised from EPREV mission will be included in the Plan after confirming of the measures of improvements among all Lithuanian institutions involved in this review.

References

1. Declaration of ENSREG - EU "Stress Tests" specifications. ENSREG, 25 May 2011.

2. Peer review report: Stress Tests Performed on European Nuclear Power Plants. ENSREG, 26 April 2012.

3. Joint statement of ENSREG and the European Commission. ENSREG, 26 April 2012.

4. Action plan: Follow-up of the peer review of the stress tests performed on European nuclear power plants. ENSREG, 25 July 2012.

5. Report on the performance of “stress-tests” at the Ignalina NPP. Ignalina NPP, 20 October 2011.

6. National final report on “stress tests”, Lithuanian State Nuclear Power Safety Inspectorate, December 2011.

7. Final report: Stress Tests Performed on European Nuclear Power Plants as a Follow-up of the Fukushima Accident. Country peer review of Lithuania. ENSREG, March 2012.

8. 2nd Extraordinary Meeting of the Contracting Parties to the Convention of Nuclear Safety, Final Summary Report, 27-31 August 2012, Vienna, Austria.

9. Main Conclusions of the 2nd Extraordinary Meeting of the Contracting Parties to the Convention on Nuclear Safety, 31 August 2012, Vienna, Austria.

10. 2nd CNS Extraordinary Meeting (August 2012) Structure, Rev.1. CNS General Committee, 16 February 2012.

11. 2nd CNS Extraordinary Meeting (August 2012) Guidance for National Reports. CNS General Committee, 2012.

12. Compilation of recommendations and suggestions: peer review of “stress tests” performed on European nuclear power plants. ENSREG, 25 July 2012.

13. Nuclear Power Facilities Equipment and Pipelines Strength Calculation Standards, PNAE G-7-002-86. Moscow, 1986.

14. Safety Analysis Report for Ignalina NPP Unit 2. Accident analysis. Chapter 6: Analysis of other accidents. Section 6.2 Analysis of impact of external events on safety of the power unit. Ignalina NPP, 2002.

15. Accidents and Technological Disfunctions Elimination Manual No 10210-1. LITGRID, Vilnius, 2011.

16. Ignalina NPP Electrical Part Accidents Elimination Instruction. Ignalina NPP, 2011.

17. Bilateral agreement between the Government of Lithuania and the Government of Latvia on early notification of nuclear accidents, exchange of information and

cooperation in the field of nuclear safety and radiation protection. Vilnius, 3 of October, 2003.

18. Bilateral agreement between the Government of Lithuania and the Government of Kingdom of Norway on early notification of nuclear accidents and exchange of information on nuclear facilities. 1998.01.14.

19. Bilateral agreement between the Government of Lithuania and the Government of Poland on early notification in case of nuclear accident and cooperation in nuclear safety and radiation safety fields. Warsaw, 1995.06.02.

20. Bilateral agreement between the Government of Lithuania and the Government of Kingdom of Denmark on early notification of nuclear accidents, exchange of information and cooperation in the field of nuclear safety and radiation protection. Copenhagen, 1993.03.16.

21. Bilateral agreement On early notification of Nuclear and Radiological Emergencies between the State Nuclear Power Safety Inspectorate of the Republic of Lithuania and the Swedish Radiation Safety Authority of the Kingdom of Sweden. Stockholm, Vilnius, 2008.12.31.

22. Law on Nuclear Energy of the Republic of Lithuania (Official Gazette, 2011, No 2-40).

23. Law on Nuclear Safety of the Republic of Lithuania (Official Gazette, 2011, No. 91-4316).

24. Nuclear safety requirements BSR-2.1.3-2010: General Requirements for the Evaluation of Nuclear Power Plant Sites. VATESI, 2011.

25. Safety Requirements NS-R-3: Site Evaluation for Nuclear Installations. IAEA, 2003.

26. Specific Safety Guide SSG-9: Seismic Hazards in Site Evaluation for Nuclear Installations. IAEA, 2010.

27. Safety Guide NS-G-3.1: External Human Induced Events in Site Evaluation for Nuclear Power Plants. IAEA, 2002.

28. Safety Guide NS-G-3.2: Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for Nuclear Power Plants. IAEA, 2002.

29. Safety Guide NS-G-3.4: Meteorological Events in Site Evaluation for Nuclear Power Plants. IAEA, 2003.

30. Safety Guide NS-G-3.5: Flood Hazard for Nuclear Power Plants on Coastal and River Sites. IAEA, 2003.

31. Safety Guide NS-G-3.6: Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plants. IAEA, 2004.