REPUBLIC OF LITHUANIA
STATE NUCLEAR POWER SAFETY INSPECTORATE

NATIONAL PROGRESS REPORT ON “STRESS TESTS”

	Prepared by	Checked by	Checked by	Approved by
Position	Expert of Safety Analysis Division	Head of Safety Analysis Division	Head of Nuclear Safety Department	Acting Head of VATESI
Name	S. Tiurin	E. Kimtys	S. Šlepavičius	M. Demčenko
Signature				
Date				

Contents

1. 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, and to provide all necessary information to the public. The European Council decided that all EU 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 of declaration which defines technical scope and the process to perform the "stress tests" and their review [1].

There is the single enterprise in Lithuania – state enterprise Ignalina Nuclear Power Plant (Ignalina NPP) – corresponding the scope of European Commission and ENSREG declaration. In response to the declaration regulatory authority of Lithuania – State Nuclear Power Safety Inspectorate (VATESI) – on 27 May 2011 enabled Ignalina NPP to perform "stress tests" for two power units, Spent Fuel Storage and New Spent Fuel Interim Storage facilities.

This position paper represents the National Progress Report of "stress tests" for Ignalina NPP in accordance with requirements stated in ENSREG declaration.

The National Progress Report is based on a "stress tests" Licensee's Progress Report and draft Final Report, which was prepared by License holder – state enterprise Ignalina NPP and presented to VATESI on 11 August 2011. The Licensee's Final Report will be provided by Ignalina NPP till 31 October 2011 and the National Final Report will be presented by VATESI till 31 December 2011. Some insignificant corrections of data in the National Final Report may be possible comparing with this National Progress Report.

Chapter 2 of this report describes general data about the Ignalina NPP site, main characteristics and significant differences of the Units, current status of the Ignalina NPP units and main characteristics of Spent Fuel Storage disposed on the Ignalina NPP site. Also Chapter 2 presents relevant PSA results of Ignalina NPP. Chapter 3 addresses the assessment of extreme situations referred in specification of ENSREG declaration, namely those are earthquake, flooding, loss of electrical power and loss of the ultimate heat sink. Chapter 4 represents main conclusions and recommendations of this National Progress Report.

2. GENERAL DATA ABOUT THE SITE/PLANT

2.1. Ignalina NPP general characteristics

Two RBMK-1500 reactors were at Ignalina NPP site. "RBMK" is the Russian acronym for "Channelized Large Power Reactor". Unit 1 of Ignalina NPP was put in operation in 1983 and Unit 2 − in 1987. In accordance with the protocol of Lithuania's EU accession the Unit 1 of Ignalina NPP was shut down by 31 December 2004 and Unit 2 was shut down by 31

December 2009. Both Units are in permanent shut down and decommissioning process is under way now. For both units separate operation licenses are valid as nuclear fuel is in units.

The Ignalina NPP site is located in the north-eastern part of Lithuania, close to the borders of Belarus and Latvia. The plant is built on the southern shores of Lake Drūkšiai and 39 km from the Ignalina town. The biggest cities located near to the Ignalina NPP are the capital of Lithuania Vilnius (130 km) with 550 thousands of habitants and Daugavpils in Latvia (30 km) − 126 thousands of habitants. The staff of Ignalina NPP lives in Visaginas town which have 29 thousands of habitants and is at distance of 6 km from Ignalina NPP.

Each Unit consists of five main buildings. Reactor buildings A1 and A2 are adjacent to a common building D1 and D2 housing the control rooms, electric instrumentation rooms and deaerator rooms. D buildings are adjacent to a common turbine hall G. The main buildings of the plant are situated about 400-500 m from the banks of Lake Drūkšiai. Both Units have the following common facilities: low-activity solid waste storage, medium- and high-activity solid waste storage, liquid waste storage, storage facility for bitumen compound, 110/330 kV switchyard, nitrogen and oxygen production facility and other auxiliary systems. During operation of both units (power regime) the 12 diesel-generators (six diesel-generators per Unit) for emergency power supply were housed in common building and physically separated from each other by walls. Currently all diesel generators at Unit 1 are put out of operation and isolated, 3 of them are conserved and 3 under dismantling process. All 6 diesel generators at Unit 2 are ready for operation. A separate water-pump service station is built for each Unit, serving the needs of uninterrupted supply of water.

Ignalina NPP has the following valid licenses:

- License for operation of Unit 1;
- License for operation of Unit 2;
- License for operation of Spent Fuel Storage Facility;
- License for operation of Cemented Waste Storage;
- Four licenses for construction of various facilities including license for construction of New Spent Fuel Interim Storage;
- License for design of Disposal Facility for Very Low Level Waste.

2.2. Main characteristics of the Units

The Ignalina NPP belongs to the category of "boiling water" reactors. As it passes through the reactor core, the cooling water is brought to boiling and is partially evaporated. The steam - water mixture is then routed to the large separator drums, the elevation of which is above the reactor. Here, the water settles down, while the steam proceeds to the turbines (two turbines at each Unit). The condensate is returned via the deaerator, by the feed pump to the water of the same separator drum. The coolant mixture is returned by the main circulation pumps to the core, where part of it is again converted to steam.

The Ignalina NPP uses an RBMK-1500 – channel-type reactor. This means that 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 must be equally divided among associated feeder pipes. After passing the core, these pipes are brought together to feed the steam-water mixture to the above mentioned separator drums. Designed thermal power of the RBMK-1500 reactor is 4800 MW, electrical power is 1500 MW. Actual power is 4200 MW and 1350 MW accordingly.

The RBMK reactors belong to the thermal neutron reactor category where graphite is used to moderate the fast fission neutrons. Four types of fuel were used:

- ^{235}U with enrichment 2%;
- ^{235}U with enrichment 2.4% and 0.41% of erbium as burnable neutron absorber;
- ^{235}U with enrichment 2.6% and 0.5% of erbium as burnable neutron absorber;
- ^{235}U with enrichment 2.8% and 0.6% of erbium as burnable neutron absorber.

2.3. Current state of the Units

Unit 1 of Ignalina NPP was shut down by 31 December 2004; Unit 2 was shut down by 31 December 2009. Both Units are under decontamination and dismantling process now.

Unit 1 state

The reactor of Ignalina NPP Unit 1 was defueled in the end of 2009. All withdrawn fuel assemblies are placed in spent fuel pools. State on 1 July 2011: 7175 fuel assemblies are stored in spent fuel pools. Taking into account safety justification documentation some of mechanical and electrical equipment is put out of operation, isolated and removed.

Unit 2 state

A part of fuel assemblies are removed from the reactor of Ignalina NPP Unit 2. State on 1 July 2011: 1335 fuel assemblies are still in reactor, and 7045 fuel assemblies are stored in spent fuel pools. Taking into account safety justification documentation some of mechanical and electrical equipment is put out of operation and isolated.

2.4. Main characteristics of Spent Fuel Storage

There are few systems of spent fuel handling and storage that perform the following functions:

- To transport the fuel assembly (FA) within the reactor building;
- To store FAs in the pool;
- To cut FAs and to put into transport cover having 102 places;
- To store transport covers with spent fuel in the pool;
- To load transport covers into cask;
- To transport casks with spent fuel to the Spent Fuel Storage;
- To store casks with spent fuel in the Spent Fuel Storage during 50 years.

Spent fuel is stored in storage pools and in Spent Fuel Storages.

Fuel storage pools

Storage pools are intended for temporary storage of spent fuel in water, screening radiation and removing heat release. There are 8 storage pools and 4 pools for handling operations. All pools for each Unit separately are situated in the reactor buildings in Storage Pool Halls. The total water surface of all pools at each Unit is 467.7 m^2. Cooling of storage pools carried out by Pump-Cooling Plant, which consists of 4 pumps and 3 heat exchangers. Each pump provides flow rate of 160 m^3/h. Main characteristics of Pump-Cooling Plant are:

- Thermal power removed 4000 kW;
- Total water flow rate in pools 400 t/h;
- Flow rate of cooling water in heat exchangers 480 t/h.

Water temperature in pools is in the range of 20°C to 50°C. The temperature safety operation limit is 60°C.

Spent Fuel Interim Storage Facility

Spent Fuel Interim Storage Facility of dry type is situated at distance of about 1 km from Unit 2 and of 400 m from Lake Drūkšiai. Spent Fuel Storage consists of operation buildings and reinforced concrete platform where dry casks with spent fuel are placed vertically. Two types of casks are used: CASTOR RBMK and CONSTOR RBMK-1500. The Spent Fuel Storage is surrounded by guarding concrete fence.

The Spent Fuel Storage is designed to store 120 casks during 50 years, including 20 of CASTOR RBMK type and 100 of CONSTOR RBMK-1500 type. At present time 20 CASTOR RBMK casks and 98 CONSTOR RBMK-1500 casks are stored; places for 2 casks are reserved for unforeseeable operations.

New Spent Fuel Interim Storage Facility

New Spent Fuel Interim Storage Facility is under construction near Ignalina NPP at distance of about 550 m. It is planned to put this facility in operation in 2012. This storage facility is intended for handling and long-term storage in special building of 201 casks of CONSTOR® RBMK-1500/M2 type with spent fuel. Storage building will be equipped with facilities to handle containers and spent fuel. There will be Reception Hall, Storage Hall, Cask Service Station and Hot Cell in the building. Design of the New Spent Fuel Interim Storage Facility takes into account possible seismic, aircraft crash and air-blast wave loadings.

2.5. Safety significant differences between Units

Design differences

There are some design differences between the first and second Units of Ignalina NPP. These differences are described in the Safety Analysis Report of Ignalina NPP Unit 1 [2]. List of most important design differences follows:

- All inner walls of Accident Localization System (ALS) compartments of Unit 2 have a tight proof steel liner. ALS compartments of Unit 1 have partly only steel liner.

- Ventilation systems of rooms adjacent to ALS compartments of Unit 1 have backup power supply from diesel-generators. There is no backup power supply of such systems of Unit 2 because ALS compartments are much more waterproof at Unit 2.

- Power supplies of control rod drives are different at Unit 1 and Unit 2.

- Sealing/locking devices of fuel assemblies are different at Unit 1 and Unit 2.
- Gas Release Cleaning Systems are different at Unit 1 and Unit 2.
- There is insignificant difference between Service Water Systems of Unit 1 and Unit 2.
- Some valves of Interim Circuit at Unit 1 are controlled manually only, whereas these valves at Unit 2 are controlled automatically.

Current differences

Now there are additional differences between Units caused by different decommissioning stages of Unit 1 and Unit 2. Main safety significant difference is that Unit 1 reactor is fully defueled whereas in Unit 2 reactor 1335 fuel assemblies remain. So, systems important to safety of spent fuel pools are in operation at Unit 1. Safety systems and systems important to safety of reactor and spent fuel pools are in operation at Unit 2. The detailed lists of systems being in operation at Unit 1 and Unit 2 and comments on those lists are given in the Ignalina NPP ”stress tests” Licensee’s Progress Report; this information will be included in the National Final Report.

2.6. Probabilistic safety assessment

Ignalina NPP Probabilistic safety analysis (PSA) was started in 1991 in the frame of “Barselina” project performed by specialists of Lithuania, Russia and Sweden. Project goal was to elaborate the line of development and the common base for risk assessment of severe accidents at RBMK reactors.

The full power PSA and shutdown PSA models of the INPP Unit 2 were developed and the method of probabilistic analysis was applied to the RBMK reactor. A number of deterministic analyses were performed to make the model realistic. Data base for NPPs with RBMK reactor was elaborated and used. The general conception of RBMK reactor analysis was developed.

Experience and information obtained at different phases of Ignalina NPP PSA were used as input for other projects improving safety. As a result of PSA some modifications were proposed and implemented. Most important modifications are reflected in the Ignalina NPP “stress tests” Licensee’s Progress Report; this information will be included in the National Final Report.

Full power PSA results showed that core damage frequency is less than 1.0E-5 per reactor year.

Shutdown PSA confirmed the results of deterministic analysis of potential events (reactivity and heat removal accidents) at shutdown reactor that at observance of operating procedures all works at shutdown reactor can be executed with the minimal risk.

3. ASSESSMENT OF EXTREME SITUATIONS

Extreme situations referred in specifications of ENSREG declaration [1] are assessed in the Ignalina NPP “stress tests” Licensee’s Progress Report, namely those are earthquake, flooding, loss of electrical power and loss of the ultimate heat sink.

3.1. Earthquake

Lithuanian territory is traditionally considered as non-seismic or low seismic zone. It depends on geological structure of the territory and long distance from tectonically active regions. On the base of instrumental investigations, historical records and generally accepted conceptions the Geological Survey of Lithuania estimates that the design basis earthquake for the Ignalina NPP area is the intensity of 6 grades on the MSK-64 scale (maximum ground acceleration is 0.5 m/s^2 = 0.05g). The beyond design basis earthquake for the Ignalina NPP area is the intensity of 7 grades on the MSK-64 scale (maximum ground acceleration is 1.0 m/s^2 = 0.1g). The design basis earthquake with the intensity of 6 grades on the MSK-64 scale corresponds to the seismic level SL-1 of the European Macroseismic Scale EMS-98 of the IAEA.

Design basis

The calculations of strength were performed for Ignalina NPP buildings and heavy equipment. It was substantiated that Reactor Building and equipment important to safety withstand earthquake of at least 6 grades on the MSK-64 scale.

Spent Fuel Storage is designed taking into account the earthquake of 6 grades on the MSK-64 scale and New Spent Fuel Interim Storage – of 7 grades. Casks of CASTOR RBMK, CONSTOR RBMK-1500 and CONSTOR® RBMK-1500/M2 types are designed to withstand the loads caused of 110g, 87g and 85g correspondingly. These design loads are many times stronger than loads caused by earthquake. Design calculations substantiate that casks of all types are stable during design basis earthquake: they will not be overturned or slid.

Evaluation of the margins

Reactor building structures, systems and components that ensure the safety of fuel storage in the Unit 2 reactor and in pools of both Units are capable to withstand the design basis earthquake taking into account possible failures of supporting systems for the time period sufficient for repair works.

Spent Fuel Storage Facility and designed New Spent Fuel Interim Storage Facility including casks of all types are capable to withstand the design basis earthquake. Safety limits of fuel sub-criticality, fuel temperature and cask external radiation will be not exceeded during and after beyond design basis earthquake taking into account possible failures of supporting systems (e.g. total long-term loss of power supply).

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. Besides, 18 acceleration sensors are installed in the reactor buildings and on steam drum separators. Data are transferred from external stations using radio link.

More detail information about Ignalina NPP stability against earthquake and about SAMS will be presented in the National Final Report.

3.2. Flooding

Lake Drūkšiai is source of cooling water for Ignalina NPP. Water levels in the Lake Drūkšiai and levels of water discharge dams (relatively the Baltic Sea level) are:

- Normal 141.6 m;
- Minimal 140.7 m;
- Maximal 142.3 m;
- Dam of „Structure 500" 143.1 m;
- Dam of River Drisviata 143.5 m;
- Dam of hydroelectric power station "Nations Friendship" 143.76 m.

Design basis

Ignalina NPP buildings and structures of interest are situated at following levels:

- Service water pump stations (lowest level) 144.0 m;
- Spent Fuel Storage 149.0 m;
- Building of diesel generators 149.5 m;
- 330/110 kV switchyard 153.15 m;
- New Spent Fuel Interim Storage 155.5 m.

Evaluation of the margins

Comparing the levels of Lake Drūkšiai and of Ignalina NPP buildings and structures and taking into account that tsunami is impossible at Lake Drūkšiai, the conclusion may be made that flooding of Ignalina NPP buildings and structures is impossible. In the worst case the level margin for service water pump stations is 0.24 m. Flooding is not included in the list of design basis accidents of spent fuel storage facilities because levels 149.0 m and 155.5 m provide margins of at least 5.24 m and 11.74 m.

More detail information will be presented in the National Final Report

3.3. Loss of electrical power and loss of the ultimate heat sink

Electrical power supply

Ignalina NPP is linked with external power supply via 110/330 kV switchyard (open distributive system): with grid of 330 kV using 6 power lines and with grid of 110 kV using 2 power lines. AC power supply may be provided from any power line of 330 kV or 110 kV.

Each Unit of Ignalina NPP is equipped with 6 diesel generators of 5600 kW each. Currently all diesel generators at Unit 1 are put out of operation and isolated, 3 of them are conserved and 3 under dismantling process. All 6 diesel generators at Unit 2 are ready for operation. Taking into account the shutdown state of both Units, fuel volume for diesel generators without refuelling is enough for operation of remaining consumers during at least 5 days.

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 put out of operation and one battery 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.

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

If the offsite power supply is lost, all diesel generators are starting automatically and provide consumers with power supply after 15 seconds.

If the offsite power supply and all diesel generators are lost (station blackout), instrumentation, communication and radioactivity monitoring systems and emergency lighting will be powered from batteries without interruption.

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.

More detail information will be presented in the National Final Report.

Ultimate heat sink

The main ultimate heat sink for the Unit 2 reactor and for spent fuel pools of both Units 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,
- Pump-Cooling Plant of Spent Fuel Pools.

Additional ultimate heat sink is atmosphere. Heat transfer from the Unit 2 reactor to atmosphere is provided by ventilation of rooms with Main Cooling Circuit pipes, blow-down of reactor space and water evaporation in Accident Localization System. Heat transfer from the spent fuel pools to atmosphere is provided as a result of water evaporation from the surface of pools.

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.

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.

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

- The critical temperature of the fuel cladding (700^oC) in the Unit 2 reactor will be reached after 6 days;
- The critical temperature of water (100^oC) in the Unit 1 spent fuel pools will be reached after 16 days;
- The critical temperature of water (100^oC) 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.

More detail information concerning the ultimate heat sink including important parameters and temperature calculations will be presented in the National Final Report.

3.4. Severe accident management

Different severe accidents are analysed in the Ignalina NPP "stress tests" Licensee's Progress Report and corresponding management, control and mitigation scenarios are proposed. Brief description follows; more detail information will be presented in the National Final Report.

State of fuel

During the period of shutdown state of the Unit 2 reactor, part of fuel assemblies were unloaded. As a result the criticality of the reactor is impossible now. The residual heat release in the fuel remaining in the reactor is significantly reduced during the shutdown period.

In case of stop cooling water flow in the reactor channels (as a result of total station blackout) there is at least 18 hours to restore power supply. There are all necessary procedures and instructions. If the power supply restoration is unsuccessful, the cooling water will be provided from independent source – borehole – using borehole pumps powered by independent diesel generator. The corresponding modification is carrying out now and all necessary procedures and instructions are under preparation as well.

As well the long-time shutdown state results in significant decrease of residual heat release in the spent fuel stored in pools. The time of temperature increase in pools from 50^oC to 95^oC is estimated of 174 hours; this time is enough to restore cooling of pools. There are all necessary procedures and instructions.

If the total station blackout occurs, water level and temperature instrumentation of spent fuel pools in both Units will be supplied from an additional mobile diesel-generator.

Hydrogen explosion

Actual source of hydrogen in the current state of Ignalina NPP is water radiolysis in spent fuel pools and in Unit 2 reactor channels.

Hydrogen generated in spent fuel pools is removed by ventilation system. The concentration of hydrogen is very low and deficient to form an explosive mixture even if ventilation system is out for a long time.

Hydrogen generated in the reactor channels may be accumulated in drum separators, steam lines and Accident Localization System (ALS). To prevent accumulation of hydrogen, the ventilation of drum separators and steam lines through open air taps and blowing of top part of ALS is performed. The design systems of hydrogen monitoring, concentration reducing and removing are still in operation during all time of reactor defueling.

Thus, hydrogen monitoring and prevention of explosive concentration is provided by design. No additional measures are needed.

Loss of electrical power

If the offsite power supply and all diesel generators are lost, all cooling pumps and ventilation systems will be inoperative. The rise of reactor core temperature will be after 18 hours.

Ignalina NPP instructions and procedures require restoring power supply and resuming operation of fuel cooling systems. If activity to restore power supply is unsuccessful, the other instruction will be used and following measures will be applied:

- The reactor cooling water will be provided from independent source – borehole – using borehole pump powered by independent diesel generator. The corresponding modification is carrying out now and all necessary procedures and instructions are under preparation.
- Instrumentation, communication and radiation monitoring systems will be powered from two additional mobile diesel generators.
- Cooling water will be fed from fire-engine(s) via fire-cock.

Water level decrease

If the water level is decreasing in any half of the Main Circulation Circuit (MCC), activities to provide reactor cooling will be carried out in accordance with instruction. In case of unsuccessful result the following special strategies will be used:

- Strategy C2 – water supply to the MCC;
- Strategy C4 – elimination of MCC leakage;
- Strategy RUZA-R1 – water supply from independent source.

Procedures intended to control beyond design accidents

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

Ignalina NPP five instructions are part of procedures intended to control beyond design accidents:

- Instruction for user of procedures to control beyond design accidents;
- Manual on control of beyond design accidents RUZA-R1. Cooling of Ignalina NPP Unit 2 reactor;
- Manual on control of beyond design accidents RUZA-RB. Decreasing of release of fission products from Ignalina NPP Units 1, 2;
- Manual on control of beyond design accidents RUZA-B. Control 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 contain a description of 10 strategies to control beyond design 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 absorber into spent fuel pools;
- Strategy C20 – isolation of damaged spent fuel pool from other pools.

Manuals on control of beyond design 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.

Rules of using of control beyond design accident procedures are established at Ignalina NPP and described in the “stress tests” Licensee’s Progress Report.

There are different facilities and tools to manage and control beyond design accidents. One permanent modification “Installation of thermocouples in the fuel assemblies at Unit 2” was implemented. Five other modifications are prepared for implementation:

- Water fitting to spent fuel pools from service water system;
- Water fitting to the Room 125 of Building A2;
- Supply of potable water to fuel channels via pipelines of repair cooling tank;
- Power supply of electrical consumers of Buildings 101/2 and 185 under total station blackout condition;
- Supply of neutron absorber into spent fuel pools.

All these modifications are described in the Ignalina NPP “stress tests” Licensee’s Progress Report.

There is enough reserve capacity of redundant pumps to provide sufficient water supply to the reactor and spent fuel pools. Shall be noted that borehole pumps have own independent diesel generator and these pumps are the last water supply source if both normal and emergency power supplies are lost.

Emergency preparedness management

New Emergency Preparedness Plan and Emergency Preparedness Operational Procedures are put in force at Ignalina NPP taking into account the shutdown state of both Units. Emergency Preparedness Organization structure and Emergency Preparedness Headquarters are established. Composition of Ignalina NPP Emergency Preparedness Organization, responsibility and training of Organization staff are described in the Ignalina NPP “stress tests” Licensee’s Progress Report. Protective measures, interactions with external organizations, technical facilities, resources, rooms and means of communication are defined in the Plan and also described in Licensee’s Progress Report.

4. PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are given in the Ignalina NPP “stress tests” Licensee’s Progress Report.

4.1. Earthquake

4.1.1. It is recommended to include the following beyond design basis earthquake scenarios for the New Spent Fuel Interim Storage:

- Turnover of the cask with spent fuel during transportation from Units to the storage site and postulated loss of cask sealing;
- Cracks or collapse of walls of cask storage hall and cask blockage by debris;
- Cracks or collapse of walls of hot cell when there is spent fuel in the hot cell.

4.1.2. It is recommended to include beyond design basis earthquake scenario of cracks or collapse of guarding concrete fence of the Spent Fuel Storage and cask blockage by debris.

4.1.3. It is recommended to examine a possibility to use signals of Seismic Alarm and Monitoring System for formalization of Emergency Preparedness criterion and subsequent including of this criterion to the Instruction of Accident Classification at Ignalina NPP.

4.2. Flooding

In the worst case of increase of Lake Drūkšiai level irrespective of cause, the Lake Drūkšiai level does not culminate the level of Ignalina NPP safety related buildings and structures.

4.3. Loss of electrical power and loss of the ultimate heat sink

4.3.1. Contract for supply of fuel shall be negotiated to ensure refuelling of diesel generators during operation over a long period of time.

4.3.2. To ensure power supply of temperature and level instrumentation of spent fuel pools it is necessary to implement new design of backup power supply from mobile diesel generator and to include addenda to corresponding procedures.

4.3.3. Additional measures are not needed to mitigate the loss of offsite power.

4.3.4. Additional measures are not needed to mitigate the loss of offsite power and backup diesel generators.

4.3.5. If the ultimate heat sink is lost, Ignalina NPP staff has enough time and necessary means to prevent cliff edge effects.

4.4. Severe accident management

4.4.1. Additional measures are not needed to compensate an impact of possible external and internal events on Ignalina NPP systems and components including feed systems of Main Circulation Circuit, reactor and spent fuel pools.

4.4.2. Unloading of 350 fuel assemblies from Unit 2 reactor and shutdown state of the reactor during long time period significantly reduced the risk of fuel damage in the reactor and pools in case of loss of cooling.

4.4.3. Feeding of the spent fuel pools and Unit 2 reactor is carried out using sufficient redundancy of feed sources right up to borehole pumps with independent diesel generator.

4.4.4. Ignalina NPP has design and process documentation, prefabricated and marked pipe sections, facilities, tools and trained personnel of Emergency Preparedness Organization to implement modifications for control of beyond design basis accidents.

5. REFERENCES

1. Declaration of ENSREG, http://ec.europa.eu/energy/nuclear/index_en.htm.

2. Safety Analysis Report of Ignalina Nuclear Power Plant Unit 1, Chapter 13, Ignalina NPP, 1996.