# SIXTH

# NATIONAL REPORT

# HUNGARY

Prepared in the Frame of the
Convention on Nuclear Safety

Budapest, 2013

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## 1. Declaration

On behalf of the Government of Hungary, the Director General of the Hungarian Atomic Energy Authority, based on details of this National Report, makes the following declaration:

Hungary states that nuclear safety is paramount during the application of nuclear energy and thus Hungary completely fulfils the conditions stipulated in the Convention and included in its spirit on the basis of the following:

- the conditions stipulated in law;
- the organizational and financial independence of the Hungarian Atomic Energy Authority and the licensing and inspection activities thereof;
- the activities carried out by the operator who is committed to the priority and continuous improvement of safety.

Budapest, August 2013

*Gyula Fichtinger*
Director General of the Hungarian Atomic Energy Authority

## 2. Introduction

**National energy policy**

*The Energy 2020 strategy of the European Union for competitive, sustainable and secure energy aimed to establish a resource and energy effective, low* $CO_2$ *emitting economy. Taking into account the emission reduction objective of the EU2020, the obsolescence of the Hungarian power plants and the influence of renewable energy sources on the system, Hungary established a long term energy strategy for the period ending in 2030 with a view to 2050. The National Energy Strategy approved by the Parliament on October 3, 2011 determined a Nuclear-Coal-Green scenario as the most realistic one and therefore established the following goals:*

- *long term sustainability of nuclear energy in the energy mix;*
- *sustaining coal based energy production for two reasons (i.e. it is the only rapidly utilizable internal reserve in an energy crisis situation e.g. sudden natural gas price increase or nuclear accident, as along with the fact that Hungarian coal reserves should be further utilized);*
- *extension of the National Action Plan for the period after 2020 from the viewpoint of the greater share of renewable energy.*

*The Parliament, in its resolution on the National Energy Strategy, concluded that the most important aspect during the peaceful application of atomic energy, and any decision relating thereto, is the safety of public health, life and fortune, thus nuclear safety has priority over any other interests. The operation of Paks Nuclear Power Plant and the maintenance of its safety, as well as the execution of periodic reviews and the development of analysis methods are inevitable.*

*The resolution requests the Government to take the necessary governmental steps in order to realize the energy policy. Accordingly, the Government:*

- *shall commence the preparatory work for the decision on new nuclear capacities at the site of Paks Nuclear Power Plant, paying special attention to its costs;*
- *shall oversee the proper realization of programmes dealing with the safe management and final disposal of nuclear wastes, and the provision of the necessary conditions.*

*Finally, the closing part of the resolution repeals the Parliament resolution of 2008 on energy policy 2008-2020.*

**The role and contribution of nuclear energy**

Paks Nuclear Power Plant, Hungary`s only nuclear power plant, operates as a shareholders' company under the name of MVM Paks Nuclear Power Plant Ltd. The contribution of nuclear energy to the total generation of electric energy was *42% in 2010, 43% in 2011 and 46% in 2012*.

| *Unit* | *Start-up* | *End of 30 years operation* | *Planned service life extension* | *Power uprate* |
|---|---|---|---|---|
| *Unit 1* | *Dec 14, 1982* | *2012* | *2032* | *500 MW – 2007* |
| *Unit 2* | *Aug 26, 1984* | *2014* | *2034* | *500 MW – 2009* |
| *Unit 3* | *Sept 15, 1986* | *2016* | *2036* | *500 MW – 2009* |
| *Unit 4* | *Aug 9, 1987* | *2017* | *2037* | *500 MW – 2006* |

*MVM Paks Nuclear Power Plant Ltd, exceeding its business plan, closed the most successful year of its history in 2012. Besides complying with the most rigorous safety regulations and keeping the environmental emissions below 1% of the regulatory limit values, it produced the most energy (i.e. 15793 GWh) thanks to the 89.9% load factor of the plant (Unit 1: 90.81%, Unit 2: 85.86%, Unit 3: 91.88%, Unit 4: 91.4%).*

**Significance of safety**

Act CXVI. of 1996 on atomic energy (hereinafter referred to as the Act on Atomic Energy) stipulates that "In the use of atomic energy, safety has priority over all other aspects", and that "The Licensee is obliged to undertake continuous activities to improve safety". This is in harmony with the spirit of the Convention on Nuclear Safety.

**International reviews**

Since its commissioning, Paks NPP has paid special attention to utilizing international experience and, at the initiative of the power plant, *35* international reviews have taken place since 1984. These include all kinds of reviews organized by the International Atomic Energy Agency. *The World Association of Nuclear Operators (WANO) conducts regular reviews at Paks Nuclear Power Plant. The follow-up of the 2nd peer-review was conducted in 2010, whilst the 3rd peer-review was conducted in 2013. The follow-up of the 3rd peer-review is planned to be conducted in 2014.*

**International relations**

Hungary maintains wide-ranging relations with various international and national nuclear organizations, professional bodies, institutes, nuclear power plants abroad, companies involved in the design, construction and installation of nuclear facilities, and research institutes.

These relations serve as a means of exchanging knowledge and experience. The fact that Hungarian experts are held internationally in high esteem is demonstrated by their active role in several committees, with many of them being board members of international organizations or invited as experts.

International partners of major importance are: the International Atomic Energy Agency (IAEA), the OECD Nuclear Energy Agency (NEA), the European Union and its organizations, the European Atomic Energy Community (EURATOM), the World Association of Nuclear Power Plant Operators (WANO), the WWER-440 operators' club, the WWER users' club, the International Nuclear Safety Program (the so-called Lisbon Initiative), the Nuclear Maintenance Experience Exchange (NUMEX), *the European Safeguards Research and Development Association (ESARDA)* and the European Atomic Energy Society (EAES). The Hungarian Nuclear Society is a member of the European Nuclear Society (ENS), and the Health Physics Section of the Roland Eötvös Physical Society is a member of the International Radiation Protection Association.

In this current report mainly the changes that have occurred since the closure of the previous national report are detailed, nevertheless all the basic principles that are still valid are repeated to present the reader with a stand-alone report. Important processes have not been omitted from the current document; the detailed descriptions are placed in the Annexes. Changes carried out in comparison with the previous report are indicated *in Italics.*

*The outcomes of the review conducted after the accident of Units 1-4 of TEPCO Fukushima Dai-ichi NPP were discussed in the report submitted to the Extraordinary Review Meeting held in August 2012. The National Action Plan established, based upon the targeted safety review is presented in Annex 8.*

The data presented in this report reflect the situation as at *December 31, 2012*.

## 3. Summary. The most important changes since submission of the previous National Report

Since the submission of the *Fifth* National Report no change has taken place in the number of nuclear installations.

Throughout their work, both the Authority and the Licensee have profited from the conclusions of the previous Review Meeting and special emphasis was given to evaluating the comments and general remarks addressed to the Report of Hungary.

The main events that have taken place since the submission of the previous National Report are the following:

### 3.1 Licensing of the operation of Unit 1 of Paks Nuclear Power Plant beyond its design lifetime

*MVM Paks Nuclear Power Plant Ltd submitted the programme in principle for the establishment of the conditions for operation beyond the design lifetime of the units and the demonstration of operability at the end of 2008. The Hungarian Atomic energy Authority evaluated the programme and ordered its execution, with certain conditions attached, prescribed in its resolution in 2009.*

*In 2011, the Authority determined the work plan for the review of the application and the background documentation, as well as the scope of clients participating in the regulatory procedure, and prepared the supporting documents.*

*Accordingly, MVM Paks Nuclear Power Plant Ltd submitted the application for the license to operate Unit 1 beyond its design service life in December 2011.*

*The information material required for a unified view in regulatory review was elaborated in January 2012, trainings were provided, and the regulatory review and evaluation were subsequently commenced.*

*The nuclear safety regulatory procedure regarding the extension of the service life is regulated by the Govt. decree 118/2011. (VII. 11.) Korm. on the nuclear safety requirements for nuclear facilities and on the corresponding regulatory activities.*

*The South-Trans-Danubian Inspectorate for Environment Protection, Nature Conversation and Water Affairs participated, as a co-authority, in the licensing procedure.*

*The review and evaluation of the tens of thousands page long application, required enormous efforts from the Authority. The realization of technical measures was verified by the Authority through on-site inspections.*

*The Authority granted the new operating license of Unit 1 in December 2012. The license received by MVM Paks Nuclear Power Plant Ltd on December 18, 2012 concluded that "The programme assuring the maintenance of the condition of systems, structures, and components providing safety functions, is at the disposal of the applicant who carries out this programme, and thus Unit 1can be further operated safely during the next 20 years".*

### 3.2 Development of regulations

*The modification of systems and components of a nuclear facility may have an effect on the nuclear safety of the facility, thus law stipulates that the categorization of modification, and the execution of safety related modifications, shall require regulatory licensing.*

*The regulation that was in effect until August 10, 2011 required a regulatory procedure having many steps. In addition to the procedure of licensing the modification in principle assessing and evaluating the safety* *compliance of the modification, regulatory license was required for the purchase and manufacturing of the modification related components. The execution of the modification also required license. Due to this multistep licensing procedure, the completion of the safety enhancement modifications suffered unnecessary delays.*

*The Nuclear Safety Code enacted in the summer of 2011 as annexes of Govt. decree 118/2011. (VII.11.) Korm. significantly simplified the regulatory licensing procedure; the modifications are licensed with the issuance of only one license.*

*In order not to decrease nuclear safety of the facility by modifications getting lower licensing attention by the Authority, the Code increases the licensing tasks of the Authority, further prescribing that the Licensee shall assess, with the involvement of experts being independent from those participating in the modification, the design documentation, the fabrication, purchase, assembly and commissioning activities.*

*The scope of inspection can include both the inspection of the documentation and the activity. If the Authority, based on the submitted documentation and the on-site inspection, identifies such non-compliance which endangers safe operation, then it either withdraws the modification license or establishes additional conditions.*

*In the case of modifications having the greatest significance to safety, the operation license of the facility concerned shall be reviewed and renewed if they comply with safety criteria and legislation.*

*An important aspect of regulation development is to take into account the recommendations of the Western European Nuclear Regulators' Association (WENRA) on international good practice, the so-called reference levels.*

*The WENRA aims at continuously developing safety, thus in addition to those that are current it deals with future nuclear power plants; it issued its statement on safety objectives of new nuclear power plants in November 2010.*

*In addition to the safety of nuclear facilities, the WENRA deals with the safety of radioactive waste management, nuclear facility decommissioning and radioactive waste disposal. The requirements are also harmonized in these areas; the second version of the harmonized requirements was published in 2010. The development of the requirement system for radioactive waste disposal was also started during that year.*

*As an outcome of the review of regulations the Govt. decree 118/2011. (VII. 11.) Korm. on the nuclear safety requirements for nuclear facilities, also on the corresponding regulatory procedures, was issued. Accordingly, Hungary fulfilled its obligation undertaken for the sake of harmonization.*

*In addition to the continuous development of IAEA recommendations and WENRA reference levels, the national regulations are refreshed more frequently than required (i.e. every 5 years). The Govt. decree and the Nuclear Safety Code were last modified in April 2012.*

*During the modification of the regulations the HAEA took, and shall take, into account the requirements for the disposal of spent nuclear fuels and decommissioning.*

### 3.3 Development of physical protection and IT security

*Govt. decree 190/2011. (IX. 19.) Korm. on the physical protection and on the corresponding licensing, reporting and inspection system established new requirements for the various applications of atomic energy. The IT security requirements are based on the NSS 17 implementation guide of the International Atomic Energy Agency along with a study made by the Computer and Automation Research Institute of the Hungarian Academy of Sciences.*

### 3.4 New definition of the safety zone

*Govt. decree 246/2011. (XI. 24.) Korm. on the safety zones of nuclear facilities and radioactive waste repositories modified the former concept of a static safety zone having a 3 km radius that was based on only the effects from the site towards the environment.*

*The new law considers the radiation exposure of the population and the environment resulting from radioactive releases during normal operation of the facility, thus it defines only the minimum size of the safety zone. In relation to the effects from the environment towards the site, the law requires the determination by analysis of the distance of effect of those industrial and other human activities having influence on the safety of the nuclear facility that are conducted in its vicinity.*

*The perimeter of the safety zone shall be revised once every 10 years (as a part of the Periodic Safety Review). In the case of new industrial facilities or other human activities planned to be built or conducted in the environment of the nuclear facility, the perimeter of the safety zone shall be determined as a part of their regulatory licensing procedure.*

### 3.5 Additional laws determining the operation of the Hungarian Atomic Energy Authority

*Govt. decree 112/2011. (VII. 4.) Korm. defines the tasks of the Hungarian Atomic Energy Authority in relation to the application of atomic energy in line with European Union and international obligations, assigns the co-authorities participating in regulatory procedures, the maximum value of financial penalties to be imposed, and the operational rules of the scientific council supporting the work of the Authority.*

*Govt. decree 247/2011. (XI. 25.) Korm. determines the conditions for affiliation and assignment of independent technical experts, who can be involved in regulatory procedures in relation to the application of atomic energy.*

### 3.6 National Action Plan for the improvement of the safety of facilities

*The European Union has not closed the European review after the accident which occurred at Units 1-4 of TEPCO Fukushima Dai-ichi nuclear power plant, instead it declared its intention to follow the implementation of the corrective measures decided upon in the Member States as an outcome of the Targeted Safety Reassessments (so-called stress tests). In this spirit, a decision on the development of National Action Plans was made at the meeting of the European Nuclear Safety Regulators (ENSREG) held on September 4-5, 2012, the plans of which had to be submitted to the European Commission by December 31, 2012.*

*The National Action Plans include the corrective actions developed during the Targeted Safety Reassessments, together with the deadlines for their completion, as well as the measures determined in issue areas identified in the second Extraordinary Review Meeting in the frame of the Convention on Nuclear Safety in August, 2012.*

*The details of the Hungarian National Action Plan are described in Annex 8.*

# A. GENERAL PROVISIONS

## 4. General provisions

**Nuclear Safety Convention, Article 4:**
Each Contracting Party shall take, within the framework of its national law, the legislative, regulatory and administrative measures and other steps necessary for implementing its obligations under this Convention.

The Republic of Hungary was one of the first nations to sign the Convention on Nuclear Safety (hereinafter referred to as the Convention) concluded in Vienna on September 20, 1994 within the framework of the International Atomic Energy Agency. Promulgation of the Convention took place in Hungary by Act I of 1997.

## 5. Reporting

**Nuclear Safety Convention, Article 5:**
Each Contracting Party shall submit for review, prior to each meeting referred to in Article 20, a report on the measures it has taken to implement each of the obligations of this Convention

This *sixth* National Report has been compiled in accordance with the requirements of the Convention and those of the related documents entitled "Guidelines Regarding National Reports under the Convention on Nuclear Safety" together with the recommendations based on the conclusions of the *fifth* Review Meeting (Vienna, 2007).

The National Report, in the order of the Articles of the Convention, includes:

- fulfilment of general provisions, and description of existing nuclear installations, mainly Paks Nuclear Power Plant (Paks NPP) as this falls under the scope of the Convention;
- characteristics of Hungarian legislation and regulations, and the role of the Authority;
- general issues of safety (including the state of financial and human resources, quality assurance, radiation protection, and emergency preparedness); and
- overview of the concrete safety analyses of the only Hungarian nuclear installation that falls under the scope of the Convention.

## 6. Existing nuclear installations

**Nuclear Safety Convention, Article 6:**
Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shut-down may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.

### 6.1 Paks Nuclear Power Plant

The scope of the Convention covers all four operating units of Paks NPP. The units were commissioned between 1983 and 1987 and are currently in good technical condition.

MVM Paks Nuclear Power Plant Ltd is a state owned economic entity. More than 99% of the shares are held by the MVM Hungarian Electricity Board Ltd (with authority granted by the state) while the remaining part is held by local governments.

### 6.1.1 Main technical attributes

The main technical data of the units of Paks NPP are summarized in Table 6.1.1

**Table 6.1.1:** Main technical attributes of units of Paks NPP

| | |
|---|---|
| Reactor type | Pressurized-water, water-cooled, water-moderated power reactor, type: V-213 |
| Thermal power of the reactor | *1485 MW* |
| Electric power output of a unit | *500 MW* |
| Number of primary loops per unit | 6 |
| Volume of the primary circuit | 237 $m^3$ |
| Pressure in the primary circuit | 123 bar |
| Average temperature of the primary coolant | *284 ±2 °C* |
| Height/diameter of the pressure vessel | 11.8 m/ 4.27 m |
| *Average* enrichment of the fuel | 2.4 - 4.2%, |
| Fuel quantity per unit | 42 tons of uranium in 349 fuel assemblies |
| Number of *turbo-machine groups* per unit | 2 |
| Pressure of secondary circuit main steam line | 43.15 bar |

MVM Paks Nuclear Power Plant Ltd operates four pressurized-water nuclear units of type WWER-440/V-213; both the moderator and the coolant of the reactors are light water. (On the basis of its safety philosophy, the power plant belongs to the group of second-generation WWER-440 nuclear power plants.) The reactor has six cooling loops, each one is connected to a steam generator. Each power plant unit is supplied with a so-called localizing tower (operating on the bubble condensing principle) connected to airtight compartments for handling any accidents caused by pipe ruptures. In these towers, trays filled with water containing boric acid are layered one above the other, completed with air traps. This system of hermetic compartments and localizing towers makes up the pressure suppression containment for the reactors.

Each unit is installed with three active safety trains, and in case of abnormal events their electrical supply might be ensured by diesel generators. These systems are supplemented by passive systems. Two saturated (wet) steam turbines operate in each unit. The original nominal thermal power of each unit was 1375 MW, and the nominal electric power outputs of the four units were 440 MW. As a result of the power uprating programme realized between 2006 and 2009, the thermal power of each unit has increased to 1485 MW and the electric power to 500 MW.

The designers of the power plant chose the so-called twin-unit version. The turbine hall is common for the four units and the reactor halls each shared by two units enable common use of high value maintenance equipment. At the same time, the main components and safety systems of the units are independent of each other. The only exception is the safety cooling water system, where the pressure line from the pumps to the pressure-equalizing tank is shared by two units.

Taking advantage of a common site and adjacent location of units, the supply systems were designed to be shared by the whole power plant.

### 6.1.2 Safety reviews

The Hungarian authority supervising the use of atomic energy, the Hungarian Atomic Energy Authority, requires submission of safety reports for licensing of the installation, and always orders the application of a quality management system. In the course of their operative work, nuclear safety inspectors are obliged to take decisions in a conservative manner biased towards safety should any not clearly assessable situation arise.

In Hungary a decree stipulates the performance of periodic safety reviews and submission of safety reports containing results of such assessments.

MVM Paks Nuclear Power Plant Ltd pays special attention on international reviews since the start of the operation. A list of international safety reviews performed at Paks NPP is included in Table *19.7.3 in Chapter 19.7.*

### 6.1.3 Safety improvement measures

*The relevant safety improvement measures that were launched between 2010 and 2012 at Paks Nuclear Power Plant are as follows:*

- *replacement of actuators of the essential service water system valves to water resistant ones;*
- *reinforcement of cooling circuit separation valves of the spent fuel pool and pipe sections between wall penetrations;*
- *management of primary to secondary leakage through blow down to the hermetic zone;*
- *hydrogen management during severe accident processes;*
- *modifications reducing the effect of high energy pipe ruptures (within the hermetic zone);*
- *external cooling of the reactor pressure vessel by flooding of the reactor cavity;*
- *modifications reducing the effect of high energy pipe ruptures (within the turbine hall);*
- *cable schedule modifications increasing system independence;*
- *independent electric supply to safety valves (autonomous supply system for accident management);*
- *modification of the actuator circuit of the cooling water pumps of the spent fuel pool;*
- *establishment of fire protection claddings and fire barriers;*
- *reduction of the load on safety distributors;*
- *relocation of I&C systems affected by high energy pipe rupture and transponder cabinets;*
- *new accident measurement system.*

*The safety improvement programmes and plans are further discussed in Chapter 20.*

*The Severe Accident Management Guidelines including the new accident management strategy were introduced in Unit 1 and 2, the modification needed for the prevention and management of accidents, as well as for the mitigation of their consequences, were completed. A part of the modifications needed in Units 3 and 4 were completed, the introduction of severe accident management is planned in 2013-2014.*

The core damage probability due to internal initiating events (i.e. one of the safety indicators of a nuclear power plant unit) decreased by a magnitude in comparison with the first assessment, both for the operating state and shutdown state (shutdown for either maintenance or refuelling) of the reactor. It is now reasonable that the further enhancement of safety primarily should focus on protection against seismic events *and external risks*.

*Taking account of all the operating states, the average probability of core damage calculated for a year due to accident processes that can be postulated as a consequence of internal caused system and component failures and inadequate human interventions, for a unit is:*

- $4.7x10^{-6}$ *for operation at nominal power;*
- $4.4x10^{-6}$ *for operating states under shut down for refuelling or overhaul;*
- $7.1x10^{-6}$ *for internal fires and floods.*

*Figure 6.1.3 shows how the core damage frequency caused by internal events decreased between 1995 and 2012.*

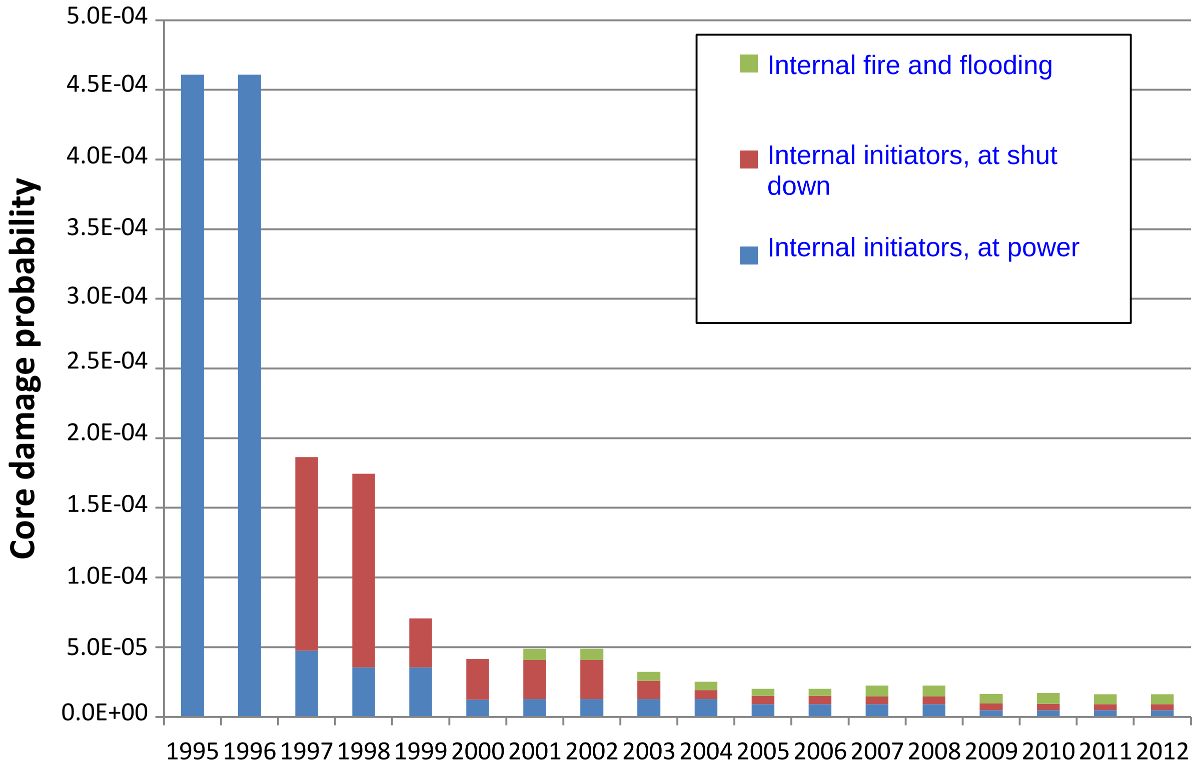



**Figure 6.1.3:** Overview of core damage frequency due to internal events

*MVM Paks NPP Ltd has performed seismic assessment of the selected reference unit and determined the value of anticipated core damage frequency. By virtue of significant similarity and architectural identity of the units, this value is valid for the other units as well. Subsequent to the reinforcement work carried out after the first assessment, and modifications made between 2010 and 2012, the calculated average value of core damage frequency of any unit of the nuclear power plant originating from an accident scenario postulated as a consequence of an earthquake is* $4.4x10^{-5}$ *per a year.*

## 6.2 Spent Fuel Interim Storage Facility

In order to store the spent fuel assemblies removed from reactors of Paks Nuclear Power Plant for a period of 50 years, a modular type dry storage facility operates next to the site of the plant.

The modules that are capable of storing fuel assemblies can be extended in a modular system. The positioning of modules in a row allows the use of a common reception building and loading equipment. Spent fuel assemblies are held individually in vertical tubes in the storage building. In order to prevent corrosion during long-term storage, the storage tubes are filled with nitrogen gas and are placed in vaults surrounded by concrete walls. The removal of residual heat generated by irradiated fuel takes place by natural flow of air through the vaults and the connected stack system. This cooling process is self-regulating. The cooling air does not come into direct contact with the fuel assemblies as they are in a hermetically sealed environment.

*The Spent Fuel Interim Storage Facility was extended by way of additional modules. Altogether 7,477 assemblies were stored in 17 storage modules at the end of 2012.*

The holder of the operating license of the Interim Spent Fuel Storage Facility is the Public Limited Company for Radioactive Waste Management.

### 6.3 Budapest Research Reactor and the Training Reactor of the Budapest University of Technology and Economics

Although these reactors do not belong to the scope of the Convention, they are considered worth mentioning here.

The Budapest Research Reactor operated by *the HAS Energy Research Centre (formerly known as the KFKI Atomic Energy Research Institute)* was built in 1959 and its full reconstruction was carried out between 1986 and 1993. In 2003 based on the results of a safety review, the Authority issued a license for further operation and for performing activities described in the Final Safety Analysis Report. The operating license is valid until revocation.

*The periodic safety review of the Budapest Research Reactor was launched in the reporting period; the Periodic Safety Review Report shall be submitted for approval by the licensee to the Authority at the beginning of 2013.*

Main technical data of the reactor:
- tank-type reactor, the tank is made of aluminium alloy;
- both coolant and moderator are light water;
- nominal thermal power is 10 MW.

In 2008, a part of the high enriched spent fuel assemblies (154.5 kg) of the Budapest Research Reactor was repatriated to the Russian Federation in the frame of the Global Threat Reduction Initiative that is financed by the United State of America.

*In addition, unused fuel and other high enriched nuclear materials were repatriated in the frame of the above contract. The remaining high enriched spent fuel will be repatriated in 2013.*

The preparation for the application of low enriched (LEU) fuel assemblies (i.e. conversion) has been started with the repatriation of the high enriched fuel assemblies in 2008. The conversion is justified by the international effort to decrease the use of high enriched (HEU) fuel that is potentially applicable to produce nuclear weapons and requires international verification. The conversion was made gradually; transient core (i.e. containing both HEU and LEU fuel assemblies) was used through four campaigns by gradually increasing the quantity of new fuel elements. In the fifth campaign (that is considered as a test campaign) the core is built only from LEU fuel assemblies. The conversion was started in 2009, *the last HEU fuel elements were removed from the reactor in 2012, the test campaign will end in 2013.*

The reactor operated by the Institute of Nuclear Techniques at the Budapest University of Technology and Economics was built in 1971 for training and research purposes. The current operating license of the Training Reactor is valid until June 30, 2017.

Main technical data of the reactor:
- pool-type reactor;
- coolant and moderator: light water;
- fuel: EK-10, 10% enrichment;
- nominal thermal power: 100 kW.

# B. LEGISLATION AND REGULATIONS

## 7. Legislative and regulatory system

**Nuclear Safety Convention, Article 7:**

1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.
2. The legislative and regulatory framework shall provide for:
   (i) the establishment of applicable national safety requirements and regulations;
   (ii) a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence;
   (iii) a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences;
   (iv) the enforcement of applicable regulations and of the terms of licences, including suspension, modification or revocation.

### 7.1 The Act on Atomic Energy

The Hungarian Parliament approved the current Act on Atomic Energy in December 1996 (the Act on Atomic Energy) which entered into force on July 1, 1997. The Act on Atomic Energy as amended considers all legislative, regulatory-related and operational experience gained during the construction and operation of Paks NPP, it considers the technological development, all international obligations, and obviously integrates the requirements of the Convention. The main criterion and key point of this is reflected in the quoted article: "In the use of nuclear energy, safety has priority over all other aspects". Those who drafted the Act on Atomic Energy utilized the recommendations of the European Union, the International Atomic Energy Agency and the OECD Nuclear Energy Agency (OECD NEA). The main characteristics of the Act on Atomic Energy are as follows:

- declaration of the overriding priority of safety;
- definition and allocation of tasks of ministries, national authorities, and bodies of competence in licensing and supervising procedures;
- entrusting the facility-level licensing authority of nuclear installations to the Hungarian Atomic Energy Authority;
- declaration of the organizational and financial independence of the Authority;
- declaration of the need for utilizing human resources, education and training, and research and development;
- definition of the responsibility of the Licensee for all damage caused by the use of nuclear energy, and fixing the sum of indemnity in accordance with the Revised Vienna Convention;
- giving the Authority the right to impose fines should rules be violated.

### 7.2. Legislative and regulatory system

#### 7.2.1 Implementation of the Act on Atomic Energy

Several government decrees and ministerial regulations have been and are issued to implement the requirements of the Act on Atomic Energy. *During the period 2010-2012 the following relevant laws were promulgated:*

*<u>Act</u>*

*Act LXXXVII of 2011 amending the Act CXVI of 1996 on the atomic energy in order to provide basis for the introduction of the new regulations on nuclear safety of nuclear facilities and on nuclear security, as well as the corresponding regulatory activities.*

*Governmental decrees*

- *Govt. decree 112/2011. (VII. 4.) Korm. on the tasks of the Hungarian Atomic Energy Authority in relation to the application of atomic energy, in line with European Union and international obligations, assigns the co-authorities participating in regulatory procedures, the maximum value of financial penalties to be imposed, and the operational rules of the scientific council supporting the work of the Authority.*
- *Govt. decree 118/2011. (VII. 11.) Korm. on the nuclear safety requirements for nuclear facilities and on the corresponding regulatory procedures.*
- *Govt. decree 190/2011. (IX. 19.) Korm. on the physical protection and on the corresponding licensing, reporting and inspection system.*
- *Govt. decree 246/2011. (XI. 24.) Korm. on the safety zones of nuclear facilities and radioactive waste repositories.*
- *Govt. decree 247/2011. (XI. 25.) Korm. on the independent technical expert proceeding in the scope of the application of atomic energy.*

*Ministerial decree*

*Ministerial decree 55/2012. (IX. 17.) NFM on the special professional training of workers employed at a nuclear facility and on those having the right to conduct activities in relation to the application of atomic energy.*

Nuclear Safety Code

*The Atomic Act requires the regular revision and update of the nuclear safety requirements for the application of atomic energy taking into account scientific results and international experience. The relevant governmental decree stipulates the periodicity as 5 years.*

*The Nuclear Safety Code was further developed in harmony with the EU nuclear safety directive (Council directive 2009/71/EURATOM), the international convention on the physical protection of nuclear materials, the safety recommendations published by the International Atomic Energy Agency in the last five years as well as the WENRA reference levels. The nuclear safety requirements of the use of atomic energy in reactor facilities are regulated by the Nuclear Safety Code issued as appendices of Govt. decree 118/2011. (VII. 11.) Korm. on the nuclear safety requirements for nuclear facilities and on the corresponding regulatory procedures as follows:*

1. *Nuclear safety regulatory procedures of nuclear facilities*
2. *Management systems of nuclear facilities*
3. *Requirements for nuclear power plant design*
4. *Operation of nuclear power plants*
5. *Design and operation of research reactors*
6. *Interim storage of spent nuclear fuel*
7. *Assessment and evaluation of the site of nuclear facilities*
8. *Decommissioning of nuclear facilities*
9. *Construction requirements for a new nuclear facility*
10. *Definitions of the Nuclear Safety Code*

*In harmony with the continuous development of IAEA recommendations and WENRA reference levels, the national regulations are refreshed more frequently than required by the law. The above listed regulations and the relating governmental decree was last modified in April 2012.*

The nuclear safety code entitles the director-general of the Authority to issue guidelines on the method how the requirements should be implemented by a licensee. Further detailed regulation of tasks originating from the implementation of legal requirements is provided by the internal rules and procedure system developed and operated by the Authority and by the Licensee.

### 7.2.2 Licensing procedure

The basic licensing principles of the establishment of nuclear facilities, and the concerned authorities taking part in licensing proceeding are regulated by Chapter III of the Act on Atomic Energy. During the licensing procedures Hungary is in compliance with the ESPOO Convention.

To establish a new nuclear power plant or a new nuclear power plant unit the preliminary consent in principle of Parliament is required for starting preparatory work, whereas to establish ownership of a nuclear power plant that is in operation or to transfer the right of operation the consent in principle of the Government is required.

In concordance with regulations in force, licenses shall be obtained from the authorities for all phases of operation (site selection, construction, commissioning, operation, decommissioning) during the lifetime of a nuclear power plant. Moreover, a separate license shall be obtained for all plant level or safety related equipment level modifications. Within the licensing proceedings, technical aspects are enforced by legally delegated co-authorities, the opinions of which shall be taken into account by the Authority.

When the installation of a new nuclear *facility* is being considered, the precondition for launching the licensing procedure is the existence of an environmental protection license.

The environmental protection authority shall hold a public hearing subsequent to the submittal of the environmental impact study. Based on the environmental impact study and on any responses received, the environmental protection authority may issue an environmental protection license for the construction and operation of the facility.

If transboundary environmental impact is possible then the partner-states should be notified by sending them the impact study. The comments provided by the partner-states are to be taken into account by the environmental authority during the licensing process conducted on the environmental impact study.

The nuclear safety related licensing of a nuclear installation takes place after the environmental licensing. The environmental protection authority plays the role of a special authority in the course of licensing a nuclear installation.

During the licensing of installations and equipment, and the nuclear safety licensing of their modifications, the contributing procedure of the environmental protection special authority provides the possibility for the civil organizations to act as clients. The decisions of the nuclear safety authority are made public.

Licenses are valid for fixed periods; at request and provided that the necessary requirements are fulfilled, they may be extended. In accordance with the Act CXL of 2004 the decisions and orders of the Authority can be appealed only through a court procedure.

Every ten years a periodic review of the safety of the nuclear power plant is performed on the basis of a comprehensive, predefined programme known as the Periodic Safety Review. Decision on the further validity and conditions of the operating license is made within the framework of the review.

*As required by the new regulations (i.e. Govt. decree 118/2011. (VII.11.) Korm.) promulgated in 2011, the safety zone of the nuclear facilities shall be revised in the course of the Periodic Safety Review. This stipulation assures the revision every ten years, even if external reasons have not made it necessary. The perimeters of the safety zone can be revised at any time based on external effects on the nuclear facility, e.g. prior to licensing of other industrial facilities in its vicinity.*

### 7.2.3 Inspection and assessment

The Act on Atomic Energy stipulates that nuclear energy can be deployed only in the way defined by law, and with regular inspections and assessments by the authorities. The licensing authority is liable to check compliance with all legal stipulations, and the safety of the application of nuclear energy.

The Authority is entitled to perform inspections either with or without advance notice, should it be justified. Such inspections may be performed regularly in order to continuously assess the safety of the nuclear power plant based on a comprehensive predefined programme or specifically related to a particular event or activity. Inspections performed by the authority are defined as observing an activity carried out on site and comparing it with the relevant documentation. The Authority prepares a programme for planned inspections, and notifies those involved in due time. Subsequent to the on-site accomplishment of the comprehensive or specific inspections, the Authority evaluates the lessons learned. Inspections or the evaluation of such inspections may also be performed by outside experts or expert bodies upon the written commission of the Authority.

In addition to the Authority's inspection activities, the co-authorities taking part in the licensing procedure also perform separate official inspections. Through agreements on cooperation in cases that concern different competences, the authorities may perform joint inspections.

In order to ensure the controlled deployment of nuclear energy and to evaluate the activity of the Licensee, the Authority operates a reporting system. The reports are detailed so as to enable independent assessment, review and evaluation of operating activities and events that have taken place. The inspection of events affecting safety that have occurred during operation and the identification of causes and the implementation of measures in order to prevent their repeated occurrence is primarily the duty of the Licensee. Any event affecting nuclear safety is required to be reported by the Licensee to the Authority in accordance with the regulations in force. On the basis of this notification and of the report prepared pertaining to the investigation carried out by the Licensee (or based on the significance of the event independently of the Licensee) the Authority analyses and evaluates the event and initiates further actions if necessary.

The Authority makes use of the evaluation results originating from various sources for evaluating the safety performance of the licensees. As a means of extending the assessment tools, the Authority introduced and applies the system of safety indicators for Paks NPP, the Spent Fuel Interim Storage Facility, the Training Reactor as well as for the Budapest Research Reactor. The term "safety indicators" means such measurable parameters, which measure the performance of the organization and the human factor.

*The safety indicators are specified basically on the basis of IAEA recommendations. They can be categorized into three major groups:*

- *attributes of smooth operation,*
- *safety characteristics of operation, and*
- *attributes of commitment to safety.*

The accumulated statistical set of indicators provides the possibility both for comprehensive evaluation and highlighting various issues. The Authority annually evaluates the safety performance of the licensees based on their regular reports. The lessons learned from evaluations are benefited during the organization of regulatory proceedings, e.g. during the compilation of the annual inspection plan.

### 7.2.4 Enforcement of legal mandates of the Authority

The conditions for enforcing legal mandates of the authorities are included in Act CXL of 2004 on general rules of administrative proceedings and services, the Act on Atomic Energy, Act IV of 1978 concerning the Penal Code, *Govt. Decree 112/2011. (VII. 4.) Korm., Govt. decree 118/2011. (VII.11.) Korm. and in Ministerial decree 47/2012. (X.4.) BM.*

Should there be any deviation from the regulations in force, the Authority may initiate an administrative proceeding to enforce the requirements of the regulation and within the framework of this may oblige the Licensee to eliminate such deviation.

The Act on Atomic Energy enables the Authority to revoke the license of the nuclear power plant, or to restrict the period of its validity.

The Authority can oblige the Licensee to pay a fine for infringing any regulation or safety standard, for failing to meet any of the stipulations of any individual regulatory license issued on the basis of the above, or failing to meet an obligatory standard. If the licensee infringes the requirements contained in the approval of the special authority involved in the licensing procedure, the Authority, at the request of the special authority, handles the fining procedure. Fining may also be used independently as an instrument of sanctioning, but it may also be accompanied by other sanctions.

The regulations in force contain the possibility to impose sanctions not only against the *nuclear facility* as an establishment, but also against individuals employed in the area of the application of nuclear energy.

Revision of the guidelines as a means of helping to fulfil the requirements of the Nuclear Safety Code is an ongoing process.

## 8. Authority

**Nuclear Safety Convention, Article 8:**

1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.
2. Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy.

### 8.1 Hungarian Atomic Energy Authority

In the case of nuclear installations as defined by Article 2 of the Convention, the competent authority in Hungary is the Hungarian Atomic Energy Authority. The Hungarian Atomic Energy Authority (the Authority) is an organizationally and financially independent, public administration body operating in the field of peaceful use of nuclear energy, under the supervision of the Government. *As of May 15, 2008 the minister for national development, acting on behalf of the Government, supervises the HAEA independently of her portfolio.*

The HAEA, as a government office, cannot be directed in its scope of authority as defined in law.

The Authority's scope of competence comprises nuclear safety licensing, *evaluation* and supervision of nuclear installations, the registration and control of radioactive materials, the licensing of transportation and packaging thereof, the licensing of nuclear exports and imports, the evaluation and co-ordination of research and development, the performance of tasks related to nuclear emergency preparedness on the site, the approval of the emergency response plans of nuclear installations, and maintenance of international relations. It is also the duty of the Authority to perform the tasks generated by the treaty on the non-proliferation of nuclear weapons, along with the accountancy for and control of nuclear materials.

*The HAEA's scope includes the licensing, reporting and inspection activity over the applications of atomic energy.*

On two occasions the activities of the Authority were surveyed by IRRT (International Regulatory Review Team) missions of the International Atomic Energy Agency.

*At the end of 2012* the departments of the Nuclear Safety Directorate were as follows:

- the Department of NPP supervision, which performs licensing and inspection procedures for Paks NPP in nuclear safety related regulatory matters as specified by law, and contributes to law-making through its experience gained during its procedures;
- the Department of Nuclear Technology and Safety Assessment, which performs licensing and inspection procedures for the spent fuel interim storage facility and the research reactors in nuclear safety related regulatory cases as specified by law, assesses the regular and event reports, and carries out the cause analysis of incidents and safety evaluation of the operators' activity;
- the Department of Technical Support, which is responsible for analysis, training and emergency preparedness;
- the Department of Strategy, which is responsible for enforcement, review and maintenance of the laws, regulations and guidelines, long term planning and preparations, and for maintaining contact with the various co-operating authorities;
- the Site Office at Paks takes care of NPP related tasks on the site.

Other official duties of the Hungarian Atomic Energy Authority, such as tasks deriving from the safeguards agreement *and the international convention on the physical protection of nuclear materials*, licensing of nuclear export-import, the registration of radioactive materials, and maintenance of international relations, are generally undertaken by the other organizational unit of the Authority, the General Nuclear Directorate.

*In the reporting period* the principal tasks of the three departments of the General Nuclear Directorate were:

- to perform the tasks imposed on Hungary by the Safeguards Agreement and Additional Protocol concerning the non-proliferation of nuclear weapons (Department of Nuclear and Radioactive Materials);
- to represent Hungary in the European Union, to elaborate the standpoints for discussions, to co-ordinate duties in connection with the law harmonization process including the analysis of regulations on radiation protection (Department of EU Co-ordination and Theoretical Radiation Protection);
- to maintain external relations and to perform tasks relating to public information (Department of External Relations).

In the licensing procedures of the Authority related to nuclear safety, the other competent administrative bodies take part as special authorities and the regulations allow the involvement of professional experts (both institutions and individuals).

In accordance with the Act on Atomic Energy, the work of the Authority is supported by a Scientific Council made up of nationally recognized individual experts.

### 8.1.1 International relations of the Hungarian Atomic Energy Authority

In accordance with the Atomic Act the HAEA is responsible for the harmonization of international cooperation in the field of peaceful use of nuclear energy and for the fulfilment of tasks originating from the cooperation with international and intergovernmental organizations.

Among the international organizations being in contact with the HAEA the most important ones are the European Union, the IAEA and the Nuclear Energy Agency of the OECD. The Authority is a member of the Network of Regulators of Countries with Small Nuclear Programmes that was initiated by Switzerland. The HAEA actively participates in the work of the Western European Nuclear Regulators' Association – WENRA, *the European Nuclear Security Regulators Association - ENSRA*, and the cooperation forum of the countries operating VVER type reactors (i.e. VVER Regulators Forum). The HAEA is a member of the European Safeguards Research and Development Association – ESARDA.

*The HAEA represents Hungary in the European Union Instrument for Nuclear Safety Co-operation programme and in the Euratom 7th Research and Development Frame Programme.*

In addition to the international organization with large membership, multilateral international cooperation was developed with certain nuclear safety authorities. In the frame of mutual information exchange, the HAEA cooperates with the authorities of the Czech Republic, Slovakia, the United States of America, Russia and Romania. The execution of the bilateral intergovernmental agreements in the field of safe use of nuclear energy falls under the competence of the HAEA.

The technical support organizations of the Authority take part in research activities coordinated by the US NRC (United States Nuclear Regulatory Commission) and in the activities of the working groups of the OECD NEA.

### 8.1.2 Communication policy of the Hungarian Atomic Energy Authority

The Authority is striving to present a thorough description of its work. It publishes newsletters every quarter on the most important events relating to the safety of nuclear energy and to its own regulatory activity. A colourful and richly illustrated information booklet on the Hungarian nuclear applications is published annually. Additionally, the HAEA informs the public by organizing press conferences and issuing press releases dealing with the most important issues concerning the safe application of atomic energy. The HAEA has an open house once a year, when the public is invited to the office building and may obtain information on the HAEA activity in the frame of presentations, exhibitions. As of October 2009 the HAEA regularly provides information on the decisions made in the field of nuclear safety by indicating the date of issuance, validity and concise summary of the subject of each decision.

An Internet-based service is integrated into the communication policy of the Authority. Besides much information, one can find the National Report on the Authority's home page both in Hungarian and in English**.**

### 8.1.3 Scientific technical background

<u>8.1.3.1 Technical support institutes</u>

During the regular technical support programmes of the recent years, the network of institutes supporting the regulatory work of the HAEA has been established. The most significant institutes of the network are: *Hungarian Academy of Sciences Centre for Energy Research (established by merging the KFKI Atomic Energy Research Institute and the HAS Institute of Isotopes),* Institute of Nuclear Techniques at the Budapest University of Technology and Economics, the Department of Radiochemistry of University of Pannonia, the *PÖYRY ERŐTERV Ltd (formerly known as ETV-ERŐTERV Ltd),* and the NUBIKI Nuclear Safety Research Institute Ltd.

It can be concluded based on the outcomes of this review that adequate contractual potential exists in each important field of expertise.

The technical support organizations carry out expert and scientific activities not only for the Authority but for nuclear installations as well. These organizations may perform contractual work for several institutions, but a particular expert or scientist is allowed to provide expertise at a given time and for a particular issue exclusively for the operator or the Authority but not for both simultaneously. The relatively comprehensive system of censure, the internal quality management system of the support organizations and the careful selection of the reviewers guarantee the appropriate consideration of interest and independent decision-making of the Authority.

<u>8.1.3.2 Technical support activity</u>

The HAEA is responsible for the harmonization of the research and development in connection with the safety of peaceful applications of nuclear energy, as well as for the financing of the technical activities providing basis for the regulatory supervision.

The strategic directions of technical activity supporting the regulatory control of safe use of nuclear energy are defined in the technical support policy of the HAEA; while the actual tasks are specified in a four-year programme. *The priorities of the technical support activities in the period of 2010-2012 were:*

- direct support to the regulatory activity;
- implementation of tasks initiated by the Authority;
- support to the tasks connecting to the new units;
- management of expertise.

*Based on the evaluation of the results, after internal and external discussion, at the end of 2012 the HAEA established the programme of the technical support activities for the next four year period (2013-2016).*

8.1.3.3 Hungarian Nuclear Knowledge Management Database

In order to effectively manage the problems of screening, using, accessing and storing information, the HAEA *established* a Knowledge Management Database for the entire Hungarian nuclear industry. The aim of the Hungarian Nuclear Knowledge Management Database is to store and actualize the expertise cumulated during the application of nuclear energy in Hungary, in harmony with the actual state of science and technology, for the present and future generation. In addition to the HAEA, licensees of nuclear installations and the lead institutes of nuclear expertise participate *in the management of the database*.

### 8.2 Independence of the Authority

The *Act XLIII of 2010* defines the concept of governmental office, according to which “a governmental office is a central public administration body established by act under the supervision of the government”…“Supervision of a governmental office is performed by a minister designated by the prime-minister” ...“A governmental office shall not be instructed in its legally defined competence”. The referred act classifies the Hungarian Atomic Energy Authority as a governmental office.

As required by the Atomic Act, the HAEA annually submits its report on the safety of Hungarian nuclear applications to the Government and the Parliament. The annual report is made public by the HAEA.

The minister of health undertakes the tasks of the Authority regarding issues related to radiation protection and concerning facility-level licensing and supervision of the storage and disposal of radioactive wastes. Other competent administrative bodies take part as special authorities in the licensing procedures.

## 9. Responsibilities of the NPP as Licensee

**Nuclear Safety Convention, Article 9**
Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

The Act on Atomic Energy primarily makes the licensee responsible for the safe use of nuclear energy and the fulfilment of safety related requirements. The basic responsibilities of the licensee are as follows:

- to establish technical, technological, financial and personal conditions for a facility's safe operation;
- to prevent the occurrence of an inadvertent and uncontrolled nuclear chain reaction;
- to prevent the evolution of any unacceptable damage to employees, local population, environment or material assets, caused by ionizing radiation or any other factor;
- to maintain the radiation exposure of employees and population to the lowest level reasonably achievable;
- to continuously monitor radiation levels and provide the local population with relevant information;
- to minimize the production of radioactive waste;
- to continuously carry out activities to improve safety, and to finance costs of related research and development activities;

- to regularly revise and upgrade its own regulatory system serving to fulfil the safety related requirements;
- to take into account the limits of human performance from the aspect of safety;
- to fulfil the obligations of Hungary arising from international contracts in the fields of peaceful use of atomic energy;
- to ensure that the qualifications, professional training and health of employees are in line with the requirements;
- to hire only those subcontractors and suppliers that have an appropriate quality management system;
- to ensure the financial coverage of liability;
- to appropriately handle extraordinary events;
- to indemnify within a limited time and under a certain amount for damages caused due to the application of atomic energy;
- to ensure the physical protection of the facility by armed guards, *and to operate an effective physical protection system*;
- to make regular payments into the Central Nuclear Financial Fund to cover costs related to the final disposal of radioactive waste, the interim storage and final disposal of irradiated fuel, and the decommissioning of the nuclear power plant.

# C. GENERAL SAFETY ISSUES

## 10. Priority to safety

**Nuclear Safety Convention, Article 10**
Each Contracting Party shall take the appropriate steps to ensure that all organizations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety.

### 10.1 Safety policy of the Authority

The various documents issued by the International Atomic Energy Agency set the basic principles of safety. These are the principles which the Authority follows and applies taking into account the fact that each country has to follow its own practice during the actual implementation. The "Safety Policy and the Operational Principles of the Authority" is the basic document of safety and it is supplemented by the Enforcement Policy.

#### 10.1.1 Objectives

The key objective of the Authority's activities is to ensure that the local population, the environment, and the operating personnel do not suffer any damage due to effects originating from ionizing radiation. The Authority exercises its control activities in order to achieve these objectives; these control activities comprise licensing, inspection, supervision, analysis, evaluation, and the enforcement of regulations.

It is also an objective of the HAEA to constantly raise the standard of safety culture both for its own operation and for the organizations under its supervision. The fulfilment of all principles and criteria defined by the Authority is the warranty for achieving the above objectives.

#### 10.1.2 Responsibility

*The Authority is responsible for licensing, inspection and evaluation of nuclear installations, systems and components in order to enforce the full compliance of the Licensee with the official requirements.*

In order to achieve these goals, the Authority shall be independent, competent and duly prepared; it shall clearly understand all processes under its supervision; and it shall be open towards the partner authorities and to the society as a whole. Every reasonable effort must be made to gain and retain the confidence of the public and it shall make itself and its objectives fully transparent to the public. The HAEA meets all the above requirements.

#### 10.1.3 Basic principles

The functioning of the Authority is regulated by the Government in accordance with the Act on Atomic Energy. The regulations governing the work and activities of the Authority are all aimed at keeping risks to a minimum, but the principle of reasonably low risk should be kept in mind at all times.

It is the responsibility of the Licensee to keep risks as low as reasonable. In the field of safety improvement measures, however, the Authority should also set a priority list.

The Authority follows the above principles in its work:
- the primary task is to minimize the frequency of technical problems and human errors that are initiators of accidents.
- mitigation of any serious consequences originating from multiple failures is a great importance. To accomplish mitigation tasks, the role of the various components in the process of accident evolution and the availability of systems suitable for relieving interventions must be known.
- the probabilistic and deterministic approaches shall be used in a complementary way when identifying weak points.

#### 10.1.4 Practical side of the Authority's work

The Authority, when performing regulatory works

- makes every effort to handle issues in a rapid and precise manner, but speed must never be allowed to jeopardize precision. If, for any reason, any uncertainty arises the Authority always decides in favour of greater safety;
- endeavours to weigh every issue according to its importance. Importance is determined in relation to safety;
- takes the licensee's viewpoints into consideration as reasonable;
- assesses the severity of incidents that may occur by processing them in a precise manner and utilizes the feed-back of experience gained in the operation process.

### 10.2 Safety policy of the NPP as a licensee

*Govt. Decree 118/2011. (VII. 11.) Korm.* concerning the implementation of the Act on Atomic Energy obliges the Licensee to prepare a safety policy that lists the Licensee's concepts and objectives related to safety and demonstrates in a convincing manner that the fulfilment of the principle of nuclear safety has priority over all other aspects.

The Safety Policy (as a document) was created in order to summarize the main safety-related activities of MVM Paks Nuclear Power Plant Ltd and to proclaim the principle of the priority of safety. It deals with defined methods of practical implementation only indirectly, since these are enforced through regulations, procedural orders, and instructions at a lower level.

The Safety Policy has uniform and thorough validity over each organizational unit and employee of the nuclear power plant. It determines the responsibilities and formulates expectations for each employee in order to maintain and enhance safety. It stresses the importance of the general responsibility of the NPP`s Director General and the particular responsibility of the Safety Director for realizing the safety and protection of the operating staff, the public, and the environment. The Safety Policy emphasizes the importance of the commitment to safety, the necessity of maintaining positive approaches to safety, the need to reveal those factors compromising safety, and to prioritize endeavours to improve the safety culture. It stresses the importance of training, information and feedback for enhancing safety.

#### 10.2.1 Responsibility of the managers

The NPP`s Director General is responsible for the proper and safe operation of the power plant as well as for quality. He is assisted by the Director of Safety who holds a transferred right of competence.

The managers are responsible, within their respective organizations for the fulfilment and enforcement of safety requirements in addition to enforcement of the Safety Policy.

In order to define various tasks, responsibilities and competence together with legal responsibilities, the NPP`s Director General set up the regulation hierarchy defined in the *Management System Manual*. Job descriptions also outline rights and competences.

#### 10.2.2 Role of personnel in maintaining operational safety

All members of the operating staff hold qualifications and have had the necessary training for carrying out their particular function. Qualifications depend on passing an examination that is either performed within the plant *(i.e. normal or advanced level plant exams)* or in front of representatives of the Authority, depending on the potential effect on safety of the particular position. Licensing examinations should be repeated at regular intervals.

The training and qualification requirements for operating staff working in shifts and employed by the operating organizations are contained in the *Ministerial decree 55/2012 (IX.17.) NFM on special* *professional and further education of employees of nuclear installations, and on the scope of professionals authorized to perform activities corresponding to use of atomic energy and the training procedures*.

Personnel doing shift work may transfer their responsibility to other individuals in a regulated manner only and under regulated circumstances, be it during normal operation or in the case of an abnormal event.

The unit control room activities of non-shift personnel are also regulated. Direct intervention in the operation process can only be executed by those holding appropriate qualifications, and they can do so only if this is set out in their job descriptions and they are on shift according to the appropriate schedule. Other personnel are forbidden to intervene directly.

It is the task and responsibility of the maintenance staff to keep all power plant equipment in a reliable and operable condition. Maintenance of the nuclear power plant is an on-going process and follows a detailed, structured format with work instructions. An administrative instruction guarantees that only those jobs are carried out that are planned and well prepared and have received the appropriate licenses. Inspection and assessment functions are integrated into the work process in a way laid down in the procedural order.

*The maintenance staff is prepared in the same training system as the operating staff. The Maintenance Training Centre of the nuclear power plant contributes to the preparedness of the staff.*

It is the task of maintenance departments to maintain and, where necessary, reconstruct any given installation, to handle equipment failures and to prepare them for official inspections, to execute all welding and technological assembly work, and to carry out repairs and assist in production tasks at the NPP, together with the planning and provision of all safety-, human resource-, and material-related conditions necessary for such work.

It is the task of the maintenance staff to document accurately all work that is carried out and to archive such documents.

The tasks of the technical support organization are as follows:

- draw up of safety analyses;
- preparation of reactor physics calculations;
- definition of the scope, time schedules and cycle times of technological tests;
- preparation, conciliation, review and modification of operating instructions, operating schemes, programming and scheduling of tests;
- keeping records of tests performed in a manner sufficiently detailed to prepare reliability and trend analyses on the basis of which conclusions can be drawn concerning the adequacy of components and systems;
- preparation of and commenting on production regulations and the upgrading thereof within the required time intervals, along with keeping records of these;
- planning and preparation of main overhauls, weekend maintenance and weekly operative works, together with the control and co-ordination of the accomplishment thereof;
- planning of in-service works and the definition of methods and conditions of implementation thereof;
- collection, arranging, recording and evaluation of data concerning main overhauls;
- composition and time scheduling of service walk-down activities;
- ensuring the availability of appropriate documentation necessary for work performance, of appropriate documentation and archiving of work performed.

Activities performed by auxiliary personnel have no direct influence on safety.

### 10.2.3 Responsibility and safety related issues concerning the employment of external suppliers

*On the premises of the nuclear power plant, work may be performed only by external suppliers holding a valid qualification approved by MVM Paks Nuclear Power Plant Ltd. Outside contractors are required to undergo re-qualification on a regular basis. Such qualifications are implemented following the requirements of the Nuclear Safety Code and the procedural order approved by the Authority, under regular inspection by the Authority. MVM Paks Nuclear Power Plant Ltd is responsible as auditor for the carrying out of the auditing and evaluating procedure and further to ensure that the conditions for qualification remain fulfilled.*

*The fulfilment of requirements of the Management System Manual – and those of the more detailed internal regulations – is mandatory for all outside organizations and suppliers performing work on the site of the nuclear power plant. The commissioning organization inspects all work performed by a supplier by appointing a technical inspector for all work.*

In the area of engineering services, analyses, calculations and assessments requiring professional knowledge are performed by research institutes, universities, or engineering offices. Co-ordination and inspection of outside work are carried out by the hiring organization.

## 11. Financial resources

**Nuclear Safety Convention, Article 11**

1. Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.
2. Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety-related activities in or for each nuclear installation, throughout its life.

### 11.1 Financial resources

### 11.1.1 Financial resources of the Authority

In order to ensure the normal operation of the Authority, the Act on Atomic Energy provides two financial sources:

- a specific sum is provided annually from the state budget:
  - to cover the costs of technical support activities assisting the regulatory work of the Authority;
  - to cover the development costs related to the emergency preparedness and response activities; and
  - to cover the costs of the Authority as a consequence of its international obligations.
- Licensees of nuclear installations are obliged to pay a supervision fee to the Authority in the manner and to the extent defined in the Act on Atomic Energy.

Thus, the Authority is financially independent of nuclear installations and its funding is sufficient for carrying out its duties efficiently. Legal guarantee had existed until October 11, 2009 that the income of HAEA, except for income from fines, shall be used exclusively for covering its operation; this guarantee has ceased by the amendment to the Atomic Act.

### 11.1.2 Financial resources of the Licensee

The MVM Paks Nuclear Power Plant Ltd (Producer) and the MVM Partner Power Trading Ltd (Trader) has concluded an "Electric Power Trading Agreement". The agreement provides the basis for the sale of the energy produced by the Producer to the Trader by 2017.

The Act on Atomic Energy called for that a fund, namely the Central Nuclear Financial Fund, be created in 1998 for financing interim storage and final disposal of radioactive wastes and spent fuel elements, *closure of the nuclear fuel cycle,* and decommissioning of nuclear installations. In order to fulfil these requirements an independent organization, the Public Limited Company for Radioactive Waste Management, was established by the HAEA. The amount to be paid into the Fund annually by the nuclear power plant is calculated by the Public Limited Company for Radioactive Waste Management on the basis of planned investment and operational costs along with international data. *These payments, after verification by the CNFF Expert Committee, are approved and promulgated by Parliament as part of the act dealing with the annual budget.* These payments, based on the Act on Atomic Energy, shall be considered when determining the price of electric energy.

### 11.2 Human resources

The Hungarian system of higher education offers a wide range of professional knowledge through the education of mechanical engineers, electrical engineers, and chemical engineers. At the Faculty of Mechanical Engineering of the Budapest University of Technology and Economics, the syllabus covers power plants and nuclear power plants within the framework of subjects related to energetics; in addition, there is a postgraduate course on nuclear engineering.

#### 11.2.1 Human resources of the Authority

Those employed by the Authority may perform official activities on their own (i.e. licensing, inspection and *evaluation* according to the general rule of public administration) only if they pass a nuclear safety or nuclear safeguards inspector's examination.

To acquaint the staff of the Authority with the practices of the power plant, their training is done mostly at the plant itself or in another form which conforms to the training system of the power plant. International courses are also integrated into the training along with "on-the-job training", which forms an integral part of the above-mentioned training system.

A systematic approach to training has been prepared by the Authority for training inspectors. The plan is based on individual training profiles and consists of three basic training types: introductory training, re-training, and advanced courses.

The basic principles governing the training system of the HAEA are as follows:

- the learning is a lifelong process;
- the most important value of the Authority are the highly qualified humans; therefore it expects and urges the acquisition and maintenance of the work-related knowledge.

*A knowledge management system was established to support the training system of the HAEA, which facilitates the transfer of knowledge from the experienced colleagues to the new ones.*

*As a stand alone the operation of a training system cannot solve each of the problems.*

*In addition to new professional challenges the regulatory work is more and more seriously hindered by the exodus of the nuclear and radiation safety graduate workers, required for the regulatory work, from the public administration. Only a few qualified professionals are in these areas of expertise, and despite the challenging tasks, the higher salary offered by engineering consultancies, expert organizations, the nuclear industry and international organizations are so attractive to the professionals needed that they cannot be offered adequate compensation within the public sector.*

*In general, the Authority can recruit young people having just graduated from the universities, who later, having gained the expertise, during the superior quality newcomer training, and also from their more experienced colleagues, due to the salary difference, leave the Authority. The number of staff in organizational units dealing with nuclear facilities is less than 40.*

*The number of staff within the Authority may be decreased by the new regulations aiming at cost reduction in the public administration; accordingly, newcomers cannot be hired to replace retired professionals.*
*The Hungarian Atomic Energy Authority, if a new nuclear power plant unit is constructed, shall perform regulatory supervision over the existing four units along with the other three nuclear facilities, which means an increasing work load required by the regulatory supervision of the ageing of nuclear equipment, equipment replacement, modernization projects and ageing management procedures.*

*As stated in the press release of the Ministry of development issued on June 6, 2012: "The date of commissioning new nuclear power plant units, as justified by the security of the national energy supply, is planned between 2025-2030." The National Energy Strategy estimates the commissioning of Unit 5 in 2025, while Unit 6 in 2030. According to studies, the period of regulatory licensing and construction lasts between eleven to twelve years at a minimum.*

*Licensing of one or two new nuclear power plant units requires additional professionals. At the request of the Government, the Hungarian Atomic Energy Authority made an assessment regarding the expertise and manpower required for a potential extension.*

### 11.2.2 Human resources of the Licensee

*As at December 31, 2012 the number of individuals employed by MVM Paks Nuclear Power Plant Ltd was 2,533 of whom 85 were heads of divisions or higher level executives. The number of those engaged in operations 845; the number of maintenance staff 595, and the number of others ensuring support (safety, security, technical, economical and human) activities 1084. 36% of the employees have a higher education degree. Of the operating personnel, 397 have a valid regulatory or advanced plant license for performing numerous types of work.*

*The official number of MVM Paks Nuclear Power Plant Ltd employees increased by 161 as of March 1, 2010, because MVM Ltd accepted the transfer of such a significant number of workers from other sister companies of MVM, in order to prevent parallel employment.*

Within the nuclear power plant, the system of expert training is well regulated; the financial, material and personal conditions are also assured by the plant. *The expert training system established at MVM Paks Nuclear Power Plant Ltd meets the international expectations and the Hungarian legal requirements. The training, in accordance with the Systematic Approach to Training methodology preferred by the International Atomic Energy Agency is job oriented and consists of a series of modules. Theoretical training is always followed by practical training. In addition to theoretical classroom training, the programmes include practical training on the simulator, in the Maintenance Training Centre or in the plant. The training is completed by way of practice under supervision in a real work environment. Each training phase is ended by an exam; at the end of a training programme the candidate obtains the right to work individually on company, advanced company or regulatory exams. However, training does not come to an end on obtaining the qualification: training courses and evaluations aimed at increasing knowledge continue together with periodic adequacy tests. Periodic exams must be passed every five years by workers employed in job positions requiring regulatory or advanced company license, while it is every three years by workers employed in job positions requiring company license. Annual medical and psychological fitness tests are also a prerequisite.*

*The general rule of the development and implementation of training programmes, the list of job positions and activities having an obligation to obtain special nuclear expertise, the content elements of training programmes are regulated in the Nuclear Safety Code, the Ministerial decree 55/2012. (IX. 17.) NFM, and in internal procedures.*

The radiation protection training involves the greatest numbers of employees. The education of those professionally engaged in radiation protection, of the operative staff, of the maintenance staff and of those performing technical assistance activities takes place separately. Workers engaged from outside on a contractual basis also have to meet the qualification and examination requirements.

MVM Paks Nuclear Power Plant Ltd trains its experts at its own cost and in its own training centres. The training infrastructure is suitably developed; facilities of the training centres are well equipped. Teachers and instructors are well qualified and well prepared and in addition to being involved in education, they are also engaged in technical development.

A full-scope simulator has been in operation in the Simulation Centre since 1989, serving all four units. The simulator has been continuously developed so as to follow the various modifications performed on the units. In addition to training of operators, the simulator plays an important role in technological development projects.

*The Maintenance Training Centre, which started its operation with the support of the International Atomic Energy Agency in 1997, is unique in the world with its genuine primary components and mechanical equipment for training workshops. A special feature is that training and education make use of full-scale primary main components (reactor vessel, steam generator, main circulating pump, etc.) under inactive conditions, equipment identical with the components built in technology systems as well as training mock-ups.*

## 12. Human factors

**Nuclear Safety Convention, Article 12**
Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.

### 12.1 Consideration of human factors

Both the Authority and the Licensee take into account the role of the human factor throughout the entire process of design, construction, licensing and operation of nuclear installations.

Probabilistic safety analyses are always carried out taking the human factor into consideration and assessing numerical values of probabilities of human error during various activities. When evaluating simulator training and potential abnormal events, further data can be derived concerning the probabilities of the occurrence of events originating from human error. In *Accordance with the expectations of the Authority, the Licensee shall put emphasis on the identification of human and management errors during event investigations.*

*As in the past, the MVM Trust wishes to  take into account the opinions and motivations of employees regarding their employer, work conditions and personal carrier opportunities in the future; therefore the conducting of a group level commitment survey was decided upon in the second half of 2012, which shall be realized in 2013.*

### 12.2 Manpower selection

Paks Nuclear Power Plant Ltd constantly enforces the requirement that only such individuals may carry out work in the nuclear power plant, who have the necessary qualifications, skills and examinations set out for the given job and in addition meet the appropriate medical, psychological and *public security* requirements.

The recruitment and employee selection process requires close cooperation between the professional organizations and the human division, since the manager of the requesting organization defines the professional requirements for the position to be filled, while the human division performs preparation, screening and evaluation.

The selection system applied by Paks Nuclear Power Plant Ltd consists of psychology aptitude test and measurement of competencies required for a given job or position. The psychologist provides the manager with a detailed evaluation on the results of aptitude tests and competence measurements, and then prepares the priority list of candidates. The most appropriate candidate is selected by the relevant leader.

In order to professionally prepare the new employees or those moved to a new position for a new job, the Paks NPP Ltd operates the system of mentor programmes.

### 12.3 Improvement of working conditions

The Collective Contract of the plant limits overtime to 4 hours per day and a total of 8 hours per week which altogether should not exceed 300 hours a year. The rules valid in the plant are in accordance with the related effective stipulations of the *Act I of 2012 on the National Labour Code*. As this means a particularly strict limitation of overtime work, the Human Affairs Directorate keeps comprehensive records of the workload of employees.

*In order to ensure undisturbed work, some while ago the NPP established and has ever since operated a social system whose scope in several areas reaches beyond the services usually available in Hungary.*

*The nuclear power plant was awarded "The healthiest Work Place" in 2011, and "Family Friendly Work Place" in 2012.*

### 12.4 Future aspects of human resources

In order to ensure a supply of adequately trained workers, the Human Affairs Directorate of the NPP constantly measures the optimum manpower demands and handles the manpower shortage or redundancy on the basis of the probable lifetime of the plant.

One of the strategic goals of the company is to extend the service life of all four units of the NPP by 20 years beyond the design lifetime. With the lifetime extension, the possibility of perspective life cycles occurs.

*The performance and competence assessment system established in 2009 operates fruitfully. The system covering each of the employees makes regular and meaningful feedback possible, as well as facilitating the differentiated motivation based on personal performance. The effective operation of the system is contributed to by the motivating financial budget separated in the salary agreement.*

### 12.5 Feedback of experience in order to enhance safety

It is laid down in the safety policy of the nuclear power plant that commitment to safety should manifest itself, among other ways, in open detection of factors compromising safety and in an endeavour to enhance safety and safety culture. The objective of event investigations is to draw conclusions rather than to call personnel into account.

Investigation and analysis of non-planned events in the nuclear power plant are regulated in a separate procedural order. Any human error found during an investigation should be analysed in detail. Specialists help to identify initiating causes, take part in the psychological analysis work as well as in defining the direction of necessary changes and modifications. The results of the investigations with definitions of the related concrete tasks and measures needed are strictly recorded.

### 12.6 Safe working conditions

Healthy working conditions in accordance with standard values are considered as a priority. If it is thought that any of these conditions in a particular workplace does not meet the requirements, accurate measurements are performed on the basis of which supplementary measures are taken. The proper use of personal protective equipment (the use of which depends on the given working conditions) is enforced by regular check-ups and the possibility of imposing sanctions.

It is a usual practice to modify or change the external conditions, the ergonomic environment or the man-machine interface so that the probability of repeating errors is reduced. All tools, measuring instruments, maintenance and all other special equipment, meet the requirements both for quality and quantity.

## 13. Quality management

**Nuclear Safety Convention, Article 13**
Each Contracting Party shall take the appropriate steps to ensure that quality assurance programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation.

### 13.1 Basic principles

In operating and developing quality management systems, nuclear safety is always the key objective.

The design, manufacture, installation, assembly, commissioning, in-service inspections, testing, etc. of the components are performed on the basis of requirements of the Nuclear Safety Code and of associated guidelines. There are still certain professional areas where Hungarian directions and standards have yet to be prepared: in these cases the approaches of those countries where an advanced nuclear industry exist in these areas are applied. It is important that the suppliers of the power plant have to be in possession of a valid qualification for the relevant activity.

### 13.2 Description of the national quality management system

The Act on Atomic Energy requires that "Only those institutions, organizations, … which possess appropriate quality management systems can take part in activities related to nuclear facilities, nuclear systems and equipment". Moreover the Act on Atomic Energy requires that in the field of application of nuclear energy only such individuals may be employed who meet all the necessary requirements, such as qualifications, and the necessary personal standards and health, etc. The adequacy of the management system shall be examined and certified.

The principles of the quality management system were included in Volume 2 of the Nuclear Safety Code, and these requirements were composed according to *Code GS-R-3* of the International Atomic Energy Agency, *based on WENRA reference levels* and by taking account of ISO 9001:2000 standard. The Volume on quality assurance and the associated guidelines define the quality management expectations not only towards the operator but also towards the suppliers.

### 13.3 Quality management system of the Authority

The HAEA was among the first of the bodies of the Hungarian central public administration to introduce a quality management system according to the standard MSZ EN ISO 9001:2001 (ISO 9001:2000).

Pursuant to the standard, the certification shall be renewed every three years and supervisory audit shall be conducted every year. *As a result of the third renewing audit that was conducted in 2012, the certification has been validated for another 3 years, until March 2015.*

### 13.4 Quality management system of the nuclear power plant

#### 13.4.1 Management

*MVM Paks Nuclear Power Plant Ltd, as the operator and licensee of the nuclear power plant, established, operates and develops its management system in line with the requirements of Volume 2 of the Nuclear Safety Code.* The fundamental principles of the management system are described in the Management System Manual, while the compliance of the system with the requirements is demonstrated in Chapter 17 of the Final Safety Analyses Report. Paks NPP Ltd has an integrated system, thus the environmental protection, physical protection, labour safety, radiation protection and fire protection requirements for the personnel were all considered beyond the quality requirements during the development thereof. The integrated approach assures that these requirements are complied with besides the overriding priority of safety. The integrated management system is a complex system, it covers the full scope of the basic activity; consequently it covers each process as well as defines the related requirements. The quality policy definitely describes the general quality related intention and direction of the higher management.

An indicator system is used to assess the correct functioning of the *quality management system* of the nuclear power plant. The indicators indirectly reflect the adequacy of the functioning of the quality assurance system, and necessary measures can be determined upon the evaluation of these indicators.

Based on annual plans, the quality management organization regularly reviews the operation of the system. The auditors reviewing the system are trained in special training; well experienced experts contribute to their work during audit of certain special areas.

Any non-conformance detected during the operation of the nuclear power plant is in all cases followed by evaluation. Depending on the severity of the non-conformance, evaluation is performed either by the Authority, the quality assurance experts of the power plant, or by experts of the given professional areas.

One of the most effective elements for developing quality assurance systems is the investigation of events at different levels and the feedback of experience. Accordingly, the nuclear power plant investigates events according to their severity and in a way regulated by procedural orders. When performing such investigations the initiating causes and necessary measures are identified.

For evaluating the efficiency of the management system and to determine the necessary corrective actions the plant management holds a management review every year.

### 13.4.2 Execution

Design work necessary for the operation of the nuclear power plant is performed by or on behalf of the various technical support organizations.

The process of procurement is fully regulated from ordering, through import to delivery, and to inspection of the delivered product.

Operating activities are accomplished in a way called for in procedures *and execution instructions*, and in the Technical Specifications. Operations are performed on the basis of handling and operating instructions. Special attention is paid to the clear identification of equipment at all times and the continuous monitoring of the condition of the given equipment. When shift changes take place, they are performed in a documented way in all cases, with a clear indication of the status of equipment valid at the moment of hand over. All necessary temporary modifications are performed according to procedural orders. Regulated fuel management procedures covering the entire cycle also form an important element of quality management of operation.

The *procedures and execution orders* ensure the proper control of the management of maintenance process. *The maintenance activities are performed based upon plans, maintenance technologies and work programmes.*

Control over technical background activities is also performed according to procedures. Requirements concerning reactor physics, diagnostic analyses, and the process for waste treatment have also been defined.

### 13.4.3 Audits

The safety and quality assurance organizations of the nuclear power plant exercise internal control over the executing organizations.

*Control manifests itself with regard to approval of documents describing execution conditions for daily activities and during on-site supervision of real execution. Additionally, control appears in the form of audits that assess the system level and practical compliance with requirements as defined for a given operational area.*

Organizations and process-owners monitor the efficiency of their own operation through self-assessment process.

*The suppliers of the power plant are assessed and qualified according to the safety relevance of their work. The qualification or assessment process audits the adequacy of the quality management systems of suppliers in a planned and documented way, particularly the efficiency of their operation.*

## 13.5 Role of the Authority in verifying the quality assurance system

The Authority performs a comprehensive inspection either as a system audit or a process audit. Audits are carried out on previously designated areas by internal auditors; any attempt to eliminate remarks recorded in the audit-minutes must be reported.

Pre-planned inspections are performed according to the annual schedule of the Authority and according to the overhaul decision for units under refuelling. Non-scheduled single inspections are performed relating to events adversely affecting quality, or upon the individual decision of the Authority.

The areas of the operator's quality assurance system regularly inspected by the Authority are as follows:

- - structure of the organization,
- - training and qualification of staff,
- - documentation,
- - management of non-conformances;
- - normal operation,
- - maintenance and repair work,
- - nuclear fuel management,
- - selection of contractors,
- - design,
- - acceptance inspection at manufacturers,
- - modifications.

Checking up on supervisions includes both independent assessments and those performed by the management. Official inspections are carried out according to written procedural orders approved by the Authority's Director General and are made known to the Licensee.

The Authority expects the Licensee to *decide upon* improvement measures related to findings identified during official inspections. If this is neglected or not performed adequately, the Authority in a special resolution will itself demand the improvement measures.

***Comprehensive inspections of processes in Paks Nuclear Power Plant***

The HAEA has in the relevant period conducted two comprehensive inspections in Paks Nuclear Power Plant.

The inspection has covered several areas being significant to operation, such as safety attitude of the management and the organization, management of suppliers, feedback of operating experience, and knowledge management.

*In 2010, the HAEA inspected the utilization of R&D results. The Authority evaluated how the information is collected, with what frequency and what are the results of the process. Planning and use of the results of the research and development activity was assessed mainly in the field of maintenance planning, power uprating and service life extension. The evaluation covered the process regulation and quality management documents.*

*In 2012, the HAEA examined the general aspects of regulations within the quality assurance principal process including verification of documentation management, regulation of the updating process of the Final Safety Analysis Report and the compliance of the actual activity with the internal regulations as well as the process and examples of deploying external experts.*

## 14. Assessment and demonstration of safety

**Nuclear Safety Convention, Article 14**

Each Contracting Party shall take the appropriate steps to ensure that:

(i) comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body;

(ii) verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions.

### 14.1 Assessment of safety

#### 14.1.1 The system of safety analysis reports

The method of preparation and application of safety analysis reports is set out by legal regulation at Government Decree level. The official procedure related to a nuclear installation is based on the Preliminary Safety Analysis Report that is followed by the Final Safety Analysis Report necessary for the commencement of operation of a given nuclear installation.

The requirements regarding the contents of safety reports are based on the requirements of Reg. Guide 1.70 of the US NRC (United States Nuclear Regulatory Commission) taking national attributes into consideration.

Govt. decree *118/2011. (VII. 11.)* Korm. stipulates that the Final Safety Analysis Report should be updated annually, so that the safety analysis report can serve as an authentic and continuous basis assessing the safety of the nuclear installation throughout its entire life-time.

The Authority performs a periodic nuclear safety review within ten years of the first day of the validity of the Operating License issued for the initial commencement of operation, and it repeats this review every ten years following the first one. Licensees are liable to perform their own internal assessment one year before the deadline set for the performance of the assessment and to submit a Periodic Safety Review Report on the results of this assessment to the Authority. *In the review the HAEA performs the analysis and evaluation of the technological and safety level of the operated nuclear installation, and compares it with the known, most recently developed international technology and safety levels. The HAEA appraises whether or not the risk, from any difference revealed, can be tolerated during the next 10 year operating cycle and if the operation of the installation is commensurate with internationally accepted good practice. The HAEA terminates the review with an authority resolution, in which it may limit the validity of the* *license if the risk justifies it, or may orders the implementation of safety improvement measures to reduce any unacceptable risk. The safety improvement is conducted under regulated conditions; the Authority inspects the improvement actions decided upon and grants permission for the relevant necessary modifications.*

The Authority issues a decision based on its own safety assessment and the Periodic Safety Review Report of the Licensee, in which it lays down the conditions for future operation.

#### 14.1.2 Periodic Safety Review

The International Atomic Energy Agency issued its recommendations concerning Periodic Safety Reviews (Periodic Safety Review of Operational Nuclear Power Plants, Safety Series No. 50-SG-O12 and NS-G-2.10 documents). This recommendation schedules regular reviews approximately every ten years thereby providing a comprehensive view of safety of nuclear power plant units and, by virtue of their systematic approach, they are suitable for defining necessary safety improvement measures and priorities.

In Hungary, the Authority issued a guideline to *each specific* Periodic Safety Review, which sets the objectives, principles of implementation, legal regulation, and technical background of the review and its related documents.

The first Periodic Safety Review of Units 1&2 of Paks NPP took place in 1995-1996. The Periodic Safety Review of Units 3&4 was performed in 1997-1998 in accordance with the new Act on Atomic Energy, entered into force in 1997, and the related regulations.

*The next Periodic Safety Review was conducted for all 4 units at the same time. The Periodic Safety Review Report was approved by the Authority on December 15, 2008 and 169 safety improvement measures were ordered to be executed in the approval resolution. The Authority follows the implementation of the improvement measures of the Periodic Safety Review and the experiences gained were used in the evaluation of the Service Life Extension Programme of Paks NPP Unit 1.*

### 14.2 Demonstration of safety

#### 14.2.1 In-service inspections and tests, material testing

The proper technical condition of nuclear power plant systems and components fulfilling safety functions shall be maintained. The proper technical condition and functionality is demonstrated by in-service inspections, inspections and tests performed in connection with main overhauls, as well as by periodic material testing of pressure retaining equipment and valves. *A detailed description of the in-service inspections and tests* is given in Annex 1.

#### 14.2.2 Ageing management of equipment

The Nuclear Safety Code, issued as an annex to *Govt. Decree 118/2011 (VII. 11.) Korm. on the nuclear safety requirements for nuclear facilities and the respective regulatory proceedings, dedicates* separate sub-sections to the topics of ageing and lifetime management. Ageing management of equipment at Paks NPP is being performed according to the Nuclear Safety Codes. Its detailed description can be found in Annex 2.

#### 14.2.3 Seismic safety

Between 1996 and 2002, the total *seismic safety* review and the implementation of complex reinforcements took place up to the final seismic input, which had been determined as 0.25g free surface horizontal acceleration.

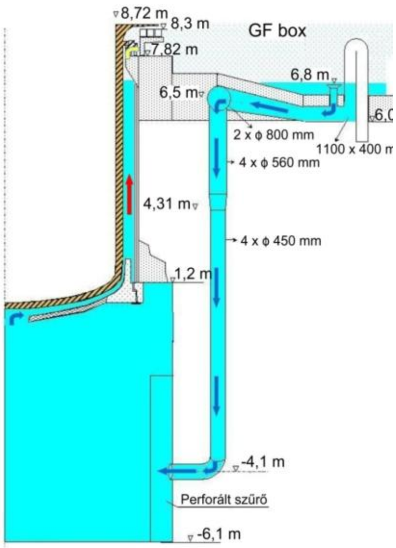
In addition to free-surface measurements, several triaxial acceleration gauges are located within each twin unit: three of them are fixed onto the base plate and three additional pieces are installed at different locations of the reactor building important from both structural and mechanical points of view. The earthquake monitoring system provides sufficient measurement data for the evaluation procedure.

Since the safety and control rods drop down in their full length into the reactor within 10 seconds, it is not justifiable to initiate automatic reactor protection operation for earthquakes of any free surface acceleration or duration. In order to prevent unit shutdowns triggered by false signals, the earthquake alarm and protection system currently operates off-line. In accordance with international recommendations and with modern practice, the criterion for unit shutdown is the transgression of limit values set for the cumulative absolute velocity and for the response spectrum. Actions to be taken in case of an earthquake are laid down in Technical Specifications and in Emergency Operating Procedures.

### 14.3 Safety improvement measures

*The severe accident management guideline sets were introduced in 2011 for Unit 1 of Paks Nuclear Power Plant, while in 2012 for Unit 2.*

*The Licensee has completed the modifications necessary to be able to implement the severe accident management guidelines. These modifications are as follows:*




- *The possibility of external cooling of the reactor pressure vessel has been established. The objective of that is to provide the capability of in-vessel retention of the molten corium in a severe accident situation, whilst the integrity of the reactor pressure vessel is maintained. The task has been accomplished by external cooling of the reactor pressure vessel by way of creating the route for draining the water reserves of the bubble condenser trays into the reactor cavity via the ventilation system of the reactor cavity. The coolant can return to the hermetic compartments from there, meanwhile it cools the vessel wall. The modification has been completed in Unit 1 and Unit 2, whilst it is to be carried out by 2014 in the other units.*

- *In order to ensure an appropriate method of management of the hydrogen generated during a severe accident phenomenon, in addition to the already hydrogen recombiners in existence, a further 60 high power recombiners have been installed in the hermetic compartments for severe accident management purposes. Hydrogen explosion and endangering of integrity of the hermetic compartments can be avoided by means of these pieces of equipment which reduce the potential for release of radioactive materials. This development was completed for all units in 2011.*

- *In order to realize the severe accident management strategy, such an accident management electric power supply system had to be constructed, which can ensure the power supply for reduction of the pressure in the main circulation loops, the equipment required for external cooling of the reactor pressure vessel and for the accident measurement and instrumentation chains should a total loss of electrical power occur should the occasion arise when there is no onsite and off-site safety power supply available. The independent electric power system has been constructed by way of the installation of mobile diesel generators and connection routes from the generators towards the principal safety distributors. This development took place for all units during 2011.*

- *Accurate monitoring, and knowledge of the technical parameters, is indispensable for the usage of the severe accident management guidelines and for correct technical decision-making. The measurement system operable even if severe accident conditions occur include measurement means for reactor pressure, core outlet temperature, water level in hermetic compartments, water level in reactor cavity, steam generator level, hermetic compartment pressure, hermetic compartment temperature, hermetic compartment hydrogen concentration, spent fuel pool level, dose-rate in reactor hall and release* *parameters. The system has already been implemented in Units 1 and 2. The modification will take place in the other units by the end of 2013. The deadline for introduction of severe accident management guidelines for the other units is the end of 2014.*

- *The safety improvement modification of the cooling circuits within the spent fuel pools and service shafts of the units are in progress. According to PSA results that such a loss of coolant accident within the spent fuel pool cooling system would entail the most severe consequences, those of which would take place in the compartments of the safety equipment of the pools at a water level of the spent fuel pool used during refuelling. In order to reduce the risk, motor-operated valves, controlled by level gauges, are being constructed in place of the currently used manual valves. In this way the amount of coolant lost can be kept within acceptable limits and it will be easier to start up the backup coolant circuit. The frequency of a break in unenclosed pipelines can be reduced by replacement of the existing pipeline sections and by applying fewer welds. As a consequence of the modification the damage frequency of the fuel in the spent fuel pool, due to loss of coolant, decreases by two orders of magnitude. The modification was implemented in 2011 in Unit 1, in 2012 in Unit 2 and 4, while it taking place during 2013 in unit 3.*

## 15. Radiation protection

**Nuclear Safety Convention, Article 15**
Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.

### 15.1 Legal background

The regulation of radiation protection belongs to the *minister responsible for health (at the completion of the report: Ministry of Human Resources)*, the technical issues of plant radiation protection is the task of the *atomic energy supervision organization (Hungarian Atomic Energy Authority).* The issue of releases and thus the protection of the environment belongs to the *minister responsible for environmental protection (at the completion of the report: Ministry of Rural Development)*; tasks related to the radioactivity of the soil, vegetation and feedstuffs belong to the competence of the *minister responsible for supervision of the food chain (at the completion of the report*: *Ministry of Rural Development*).

The Act on Atomic Energy allocates regulatory and professional administrative tasks to several authorities and defines the tasks of the users of nuclear energy. The major regulations that are currently applied in the field of general radiation protection are as follows:

- Ministerial Decree 16/2000. (VI. 8.) EüM of the Minister of Health on the implementation of certain provisions of the Act on Atomic Energy lays down the basis of radiation protection according to the recommendations of the ICRP (International Commission on Radiological Protection) 60 and the IAEA Safety Series-115. It contains commensurate regulation with the council directive 96/29/Euratom laying down general standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation. The decree stipulates that a radiation protection service should be set up in all installations applying nuclear energy. All users are obliged to prepare an internal radiation protection rule, which should be approved by the Office of the Chief Medical Officer of the National Public Health and Medical Officer Service and the radiation health decentre of the public health administration organization of the territorially competent capital or county government office. The annexes of the Decree specify the limits of doses of workers and members of the public; the radiation safety principles of workplaces, rules of radiation protection training; dosimetry control; the treatment of those suffering from a radiation injury; the tasks of the radiation protection service, emergency preparedness, and the special radiation protection requirements for nuclear power plants.

- The Ministerial Decree 15/2001. (VI. 6.) KöM of the Minister of Environmental Protection derives the annual release limits based on the dose constraints determined by the Office of the Chief Medical Officer.

- Govt. Decree 275/2002. (XII. 21.) Korm. on monitoring of national radiological conditions and radioactive material concentration aims at adapting the recommendation 2000/473/Euratom (VI. 8.) of the European Commission into the Hungarian legal system. The recommendation, in which foodstuffs also appear besides environmental issues, requires monitoring of radioactivity in the environment in order to assess public exposure. The governmental decree has created the database and organization of the National Environmental Radiation Control System whose tasks are:
  - acquisition of measurement results on environmental dose-rates, on radioactive isotopes in environmental elements, in foodstuffs, in structural and raw materials, on concentration of radon activity, on radioactive contamination of human bodies;
  - public information on monitoring results;
  - co-operation in information of the European Commission;
  - publication of inspection results in annual reports.

- Ministerial Decree 47/2003. (VIII. 8.) ESZCSM of the Minister of Health, Social and Family Affairs stipulates the conditions of interim storage and final disposal of radioactive wastes. Concerning the final disposal, after closure, the public limit is set at 100 μSv/year effective dose, while the risk limit for beyond design basis events is set at $10^{-5}$ case/year.

- *Govt. decree 118/2011. (VII. 11.) Korm.* placed the technical issues of radiation protection related to nuclear installations and their systems and equipment in the Authority's scope of competence. These issues are addressed in the Nuclear Safety Code, the volumes of which are the appendices of the Decree.

- Volume 1 of the Nuclear Safety Code prescribes the regular analysis of radiation protection indicators of operation and utilization of experience within the framework of the periodic safety review.

- Volume 3 sets out the main radiation protection principles related to the design of nuclear power plants, the stipulations concerning the handling of fresh and irradiated fuel and radioactive waste, and requirements for dosimetry control systems, biological shielding, and systems influencing radioactive release.

- Volume 4, *containing the requirements for operation*, summarizes requirements concerning the execution and documentation of radiation protection activities. The same volume deals with the requirements relating to management of nuclear fuel and radioactive wastes.

## 15.2 System of dose limitation

The following table summarizes the dose limits set in the domestic regulations.

**Table 15.2** Annual dose limits for workers and for members of the public[1]

| Limited quantity | Persons subjected to exposure | | |
|---|---|---|---|
| | Workers [2] (above 18 years) | Students and apprentices[3] | Members of the public |
| Effective dose | 100 mSv/5 years, and within this 50mSv/year | 6 mSv/year | 1 mSv/year |
| Dose equivalent for the lens of an eye | 150 mSv/year | 50 mSv/year | 15 mSv/year |
| Dose equivalent in skin and extremities | 500 mSv/year | 150 mSv/year | 50 mSv/year |

Remarks:

(1) These limits apply to all exposures received from external and internal man-made sources, except for medical exposures.

(2) Pregnant women are not permitted to be occupationally exposed.
Breast-feeding mothers are not allowed to work with unsealed sources.
Under special circumstances higher exposures may be permitted for volunteers provided that the doses received shall not exceed 50 mSv/year and the period of permission shall not exceed 5 years.

(3) These limits apply to apprentices and students aged between 16 and 18 years who are participants in a specialized course on subjects concerned with radiation and its use. For all other secondary school students, the dose limits are identical with the limits for members of the public.

## 15.3 Occupational exposure at Paks Nuclear Power Plant

### 15.3.1 Patterns of annual exposure

Based on the Workplace Radiation Protection Rules of Paks Nuclear Power Plant and the respective laws, every worker employed in a radiation hazardous post (including both outside and plant employees) are monitored by a regulatory film dosimeter, which is carried out by the National Personal Dosimetry Control Service of the „Frédéric Joliot-Curie” National Research Institute for Radiobiology and Radiohygiene. The internal rules of Paks NPP require full-scope operative dosimetry inspection. In accordance with these rules, every such worker has to wear an electronic dosimeter who performs activity within the controlled area.

The following charts demonstrate the maximum individual doses of workers and the annual collective doses, based on officially evaluated measurements of film dosimeters:

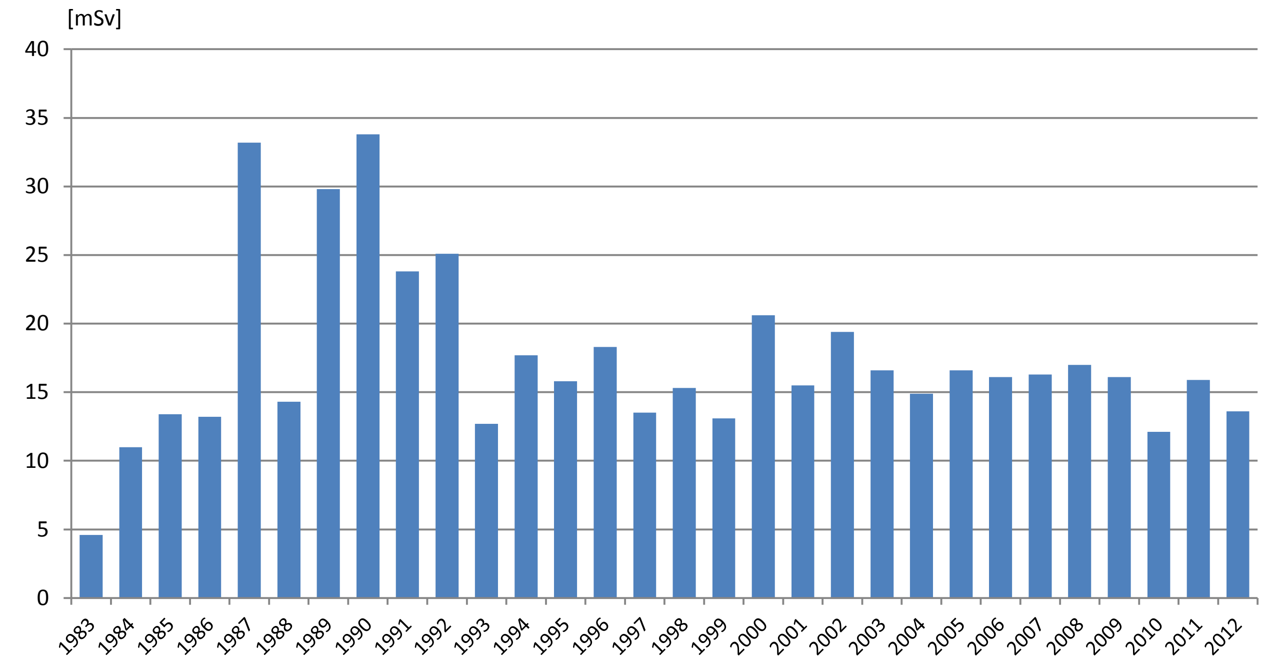



**Figure 15.3.1-1.** Maximum annual individual doses according to regulatory film-dosimeter readings

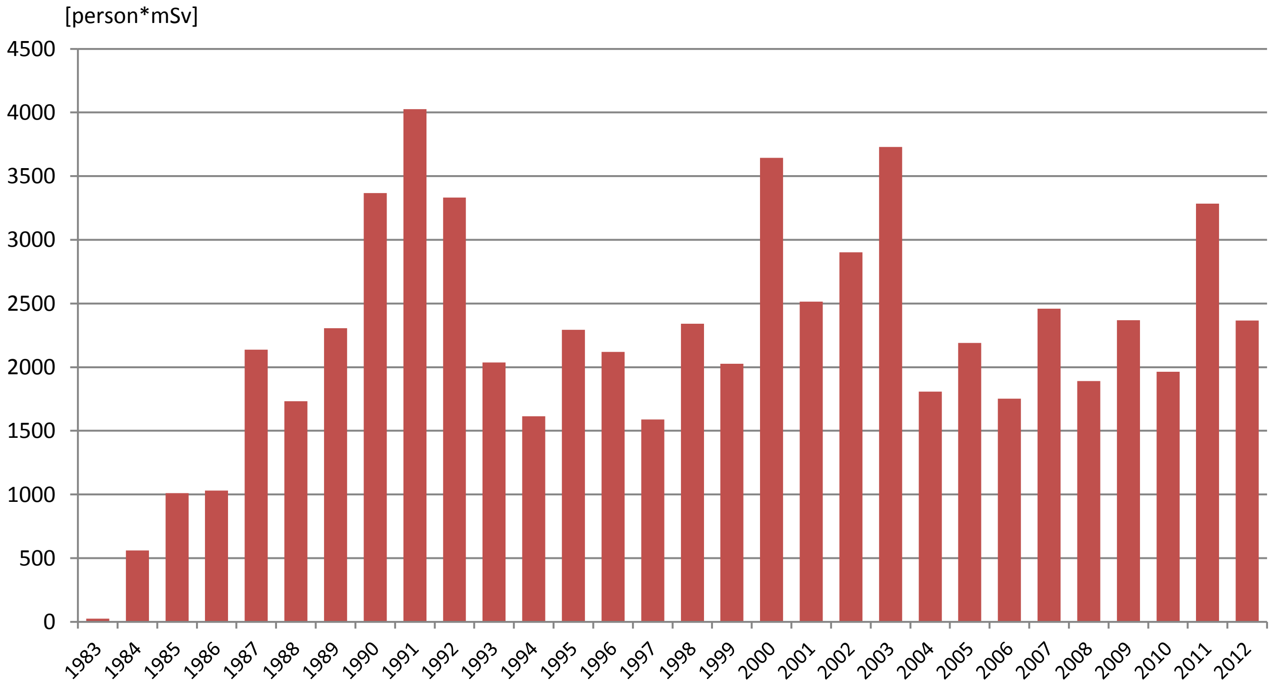



**Figure 15.3.1-2** Annual collective doses according to regulatory film dosimeter readings

### 15.3.2 Annual collective doses according to regulatory film dosimeter readings

At Paks NPP most radiation exposure of the personnel originates from overhauling activities during outages. Taking into account the low share of the radiation burden during operational periods, it is well worth while to evaluate the radiation exposure of personnel by analysing the radiation exposure received during outages.

The dose planning, radiological permission of particular maintenance operations and identification of necessary radiation protection measures are based on the comprehensive radiation level measuring programme performed by the health physics personnel in the introductory phase of the overhaul period just after shutdown of the unit in the immediate surroundings of main components and in rooms involved in overhaul work. Data gathered on the radiation conditions could be used for dose planning for the coming years.

As for the personnel performing the maintenance and maintenance related activities, the dose values were determined on the basis of dose values received at the power plant. Collective doses for the period 2010-2012 can be observed in the following table.

**Table 15.3.2-1:** Exposure of maintenance personnel between 2010 and 2012

| ***unit/year*** | ***collective dose [person*mSv]*** | | |
|---|---|---|---|
| | ***2010*** | ***2011*** | ***2012*** |
| *I* | *297* | *1255* | *370* |
| *II* | *385* | *437* | *969* |
| *III* | *256* | *347* | *210* |
| *IV* | *413* | *189* | *157* |

*Paks Nuclear Power Plant also regularly checks the evolution of internal exposure, via thyroid and tritium excretion measurements, and via whole body measurements. Internal exposure generally has a very low contribution to the annual exposure of workers. Between 2010 and 2012, no internal exposure exceeding the investigation level of 0.1 mSv took place. Concerning the tritium activity-concentration measurement in urine, values reaching or exceeding the recording level (2.5 Bq/cm3) are included in the following table:*

***Table 15.3.2-2:*** *Tritium activity-concentration values measured in urine exceeding the recording level of 2.5Bq/cm$^3$*

| ***year*** | ***number of events*** | ***max. concentration [Bq/cm$^3$]*** | ***max. committed effective dose [µSv]*** |
|---|---|---|---|
| *2010* | *3* | *5.1* | *10* |
| *2011* | *29* | *37.7* | *55* |
| *2012* | *18* | *36.7* | *75* |

The power plant itself performs the dosimetry control of workers employed from outside companies.

Summing up, it can be established that the official dose limits have not been exceeded during the operation of the power plant. The radiation exposure of the personnel shows an acceptably low level - also in terms of international comparison.

### 15.3.3 Application of the ALARA principle

At Paks NPP, optimal radiation protection is ensured by administrative and technical measures.

Technical standards comprise measures aimed at providing protection through distancing, reduction of the radiation field, and minimization of the time spent in the radiation field. During unit overhauls, a technical measure that is used is the shutdown cooling schedule, aimed at reducing the deposition of corrosion products during cool-down.

When making preparations for work under particularly dangerous radiation conditions, a qualitative ALARA programme is developed for all activities where this is justified by the radiation dose rate of the working area (> 4 mSv/h) or by the type of the activity. The programmes contain all technical and administrative measures that are needed to achieve the optimal radiation protection of the activity in question.

### 15.4 Radiation exposure of the public in the vicinity of the nuclear power plant

#### 15.4.1 Atmospheric and liquid release

The dose constraint for radiation dose increment as a consequence of a release considering the most affected group of the population in the vicinity of Paks site is 100 μSv/year (90 μSv/year for Paks NPP and 10 μSv/year for the Spent Fuel Interim Storage Facility). The release limitation system, required by the Ministerial Decree 15/2001. (VI. 6.) KöM of Minister of Environmental Protection, compares both the effluent and atmospheric releases to the isotope specific release limits derived from the dose constraints (90 μSv) determined for the plant. Compliance with limits shall be demonstrated by calculating the release limit criterion.

The release limit shall be derived for all types of releases and for all such radionuclide or radionuclide groups that are assumed to be released.
Calculation of release limit criterion:

$$\sum_{ij} \frac{R_{ij}}{El_{ij}} \leq 1;$$

where:
$El_{ij}$: release limit for radionuclide i for release type j (Bq/year);
$R_{ij}$: annual release of radionuclide i for release type j (Bq/year);

*The usage of the release limit during the last three years is outlined in Table 15.4.1. The data of the table clearly show that the releases were very low.*

***Table 15.4.1.*** *Usage of release limit at the four units*

| *year* | *number of operating units* | *limit usage [%]* |
|---|---|---|
| *2010* | *4* | *0.25* |
| *2011* | *4* | *0.20* |
| *2012* | *4* | *0.26* |

### 15.5 Radiation protection control of the nuclear power plant and the environmental monitoring system

The site of the power plant is divided into 2 zones: a free access zone and a controlled zone. Radiation levels in the free access zone may not exceed 1 μSv/h. Within the controlled zone, compartments are classified into 3 categories according to permitted radiation levels and surface contamination. These are manageable, restricted manageable and not manageable compartments. Radiation protection is continuously monitored on the plant`s premises by a radiation protection system with 625 measurement channels. Control includes measurement of dose rates and air-activity concentrations in the various compartments, and measurement of the activity of different technological media. Signals from detectors are transmitted to the Dosimetry Control Room, where they are visually displayed with audio warning (alarm and emergency levels). In addition to the radiation protection system, local measurements and laboratory tests of samples are performed as well.

Release and environment monitoring is carried out in two fundamental ways:

- the on-line system has a telemetric system the units of which are situated at stacks (iodine and noble gas activity, aerosol and airflow measurement), at water sampling stations (total gamma activity measurement), at the meteorological tower, at Type-A environmental monitoring stations (air aerosol and iodine activity, gamma dose rate) and at type-G environmental monitoring stations set up at about 1.5 km from the power plant.
- off-line laboratory measurements serve to enhance the accuracy of data given by the remote measuring system.

The remote data are complemented with sensitive laboratory measurements of a large quantity of samples taken from emissions and from the environment. *The stations perform off-line measurements of fall-out, grass, soil, aerosol, iodine, $^{14}C$, atmospheric tritium activities and doses (via TL detectors).*

*In addition, type-C sampling stations, which measure doses (via TL detectors), are situated within a 30 km radius of the nuclear power plant. Regular replacement and evaluation is part of the environmental monitoring programme.* Moreover, numerous samples are collected in the environment surrounding the power plant, e.g. water, mud, fish, plants, milk and soil. So far, measurements have shown only in some cases and only insignificant amounts of radioisotope activity generated by the nuclear power plant in the environment; the additional dose of the population from releases is below the nSv/year range.

At the Spent Fuel Interim Storage Facility radiation protection monitoring was also commenced on both the site and the surroundings of the facility. Experience so far shows radiation levels to be very low, and the additional exposure of the population caused by releases is below the nSv/year range.

Monitoring of releases and the environment is constantly carried out by the competent authorities as well, independently of the monitoring system operated by the Licensee. Generally speaking, the same monitoring results were obtained.

### 15.6 Radiation protection activities of the authorities

As described under Section 15.1, as far as general radiation protection is concerned the scopes of competence are shared among the HAEA, *the Office of The Chief Medical Officer of National Public Health and Medical Officer Service and, under its supervision, the radiation health decentre of the public health administration organization of the county local government office, along with the Ministry of Rural Development*. The measurement system of authorities consists of several monitoring networks completing each other, which belong to departments in accordance with the task-sharing specified in the Act on Atomic Energy.

*The Radiation Health Decentre of the Public Health Administration Organization of the Tolna County local Government Office, by way of the involvement of the "Frédéric Joliot-Curie" National Research Institute for Radiobiology and Radiohygiene, as a professional organization*, regularly inspects the workplace radiation protection conditions of the nuclear power plant.

Regular and unscheduled inspections of the Authority include partly the analysis of documentation on such inspections and partly the performance of site inspections in the following fields of technical radiation protection:

- assessment of source of radiation;
- operation of systems providing operational adequacy;
- technical radiation protection during maintenance;
- management and collection of radioactive wastes;
- abnormal radiation situations.

The competent Section of the South-Transdanubian Environmental, Nature Conservation and Water Management Inspectorate verifies the fulfilment of requirements related to discharge limits and other environmental stipulations contained in resolutions applicable to Paks NPP. The Inspectorate is an environmental protection licensing authority of the first instance but it also participates in other licensing procedures as a special authority.

Various activity concentrations of soil, veterinary and foodstuff are monitored by National Public Health and Medical Officer Service, „Frédéric Joliot-Curie” National Research Institute for Radiobiology and Radiohygiene, the South-Transdanubian Environmental Protection and Water Management Inspectorate and the central regionally competent control laboratories of the National Food Chain Safety Office.

*The Environmental Radiation Protection Monitoring System of the authorities performs, independently of Paks Nuclear Power Plant, local measurements, sampling, and laboratory tests in order to check the fulfilment of radiation protection requirements, bearing in mind however that monitoring is primarily the task of the operator*. The Data Acquisition, Evaluating and Processing Centre of the system was set up in the „Frédéric Joliot-Curie” National Research Institute for Radiobiology and Radiation Hygiene. The Authority has evaluated the radiation protection aspects of the operation of the plant in annual reports published since 1984. As it is generally not possible to trace radioactive substances released by the plant into the environment, or it is possible only in a few specific cases, the radiation doses of the public can be estimated only by migration and food-chain models. Annual effective doses estimated for a distance of 3 km fell into the 100-500 nSv range.

Besides the regulatory system, other monitoring systems also operate within the country. In order to collect monitoring results measured at various places into one central database the Government created, at the end of 2002, the National Environmental Radiation Monitoring System (OKSER). The chairperson of the committee managing OKSER *is a professional designated by the minister supervising the HAEA*, while the Information Centre operates in the National Research Institute for Radiobiology and Radiation Hygiene. OKSER, in its annual report, publishes the most important data with a summary evaluation. *The OSKER data is is available to the public in compliance with the Aarhus Convention.*

Continuous measurement and monitoring of the national radiation levels, generation of information for the alert and notification of the national nuclear emergency response system are the tasks of the National Radiation Monitoring and Notification System (OSJER). The leading organization of the OSJER is the Nuclear Emergency Information and Evaluation Centre of the BM National Directorate General for Disaster Management. The OSJER by its leading organization supports the monitoring of public radiation exposure by the data obtained from the remote radiological monitoring system.

## 16. Emergency preparedness

**Nuclear Safety Convention, Article 16**

1. Each Contracting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency. For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the regulatory body.
2. Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.
3. Contracting Parties which do not have a nuclear installation on their territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear installation in the vicinity, shall take the appropriate steps for the preparation and testing of emergency plans for their territory that cover the activities to be carried out in the event of such an emergency.

## 16.1 Emergency response plans and programmes

### 16.1.1 Regulatory framework

*During recent years, in order to align it with the current state administration structure, the laws governing the national disaster management and nuclear emergency preparedness and response system have been renewed.*

*As specified by the law CXVIII of 2011 on disaster management, and on the amendment of the related acts, the events causing unplanned dispersion of radioactive materials or radiation exposure and which unfavourably affect the safety further causing unplanned radiation exposure of the public leads to an emergency situation/event.*

*Govt. Decree 234/2011. (XI.10.) Korm. and the Govt. Resolution 1150/2012 (V.15.) Korm. on establishment along with the rules of organization and operation of the Disaster Management Coordination Inter-ministerial Committee, regulate the structure of the national disaster management system, the prevention, preparation and response related tasks of the ministers and state organizations involved in the response to disasters as well as the tasks of the disaster management coordination organization of the government.*

### 16.1.2 Operation of the Hungarian Nuclear Emergency Response System

The structure and tasks of the National Nuclear Emergency Preparedness System are outlines by *Govt. Decree 167/2010 (V. 11.) Korm.*

Under normal circumstances, organizations of the Hungarian Nuclear Emergency Response System carry out preparatory work and training: several organizations perform on-going tasks related to data acquisition, planning, information or co-operation.

If a nuclear accident occurs, it is the task of the Nuclear Emergency Response Working Committee to provide the professional decision support.

Within the nuclear installation, the person responsible for implementing tasks related to the response to a nuclear emergency is the chief executive of the installation; outside of the nuclear installation, in the counties and in the capital it is the chairperson of the regionally competent County (Capital) Defence Committee, while at national level it is the chairperson of the *Disaster Management Co-ordination Inter-ministerial Committee.*

*It is an important change at regional level in the defence administration system, that the chairperson of the County Defence Committee is the government's commissioner, his/her deputy is, as far as response to disasters is concerned, the manager of the regional office of the professional disaster management organization. The local defence committee is a body. Its chairperson is the mayor of the cities with county rights, towns and the capital, while the deputies are, as far as response to disasters is concerned, the persons designated by the manager of the regional office of the professional disaster management organization.*

In nuclear emergency, it is the task of the user of atomic energy and the atomic energy supervision organization, that is the Hungarian Atomic Energy Authority, to evaluate the nuclear safety and radiation conditions. Data and information for evaluation and decision-making are provided by the Centre for Emergency Response, Training and Analysis (CERTA) of the Hungarian Atomic Energy Authority, Nuclear Emergency Information and Evaluation Centre operated by the National Directorate General for Disaster Management (BM OKF NBIÉK), Information Centre of the National Environmental Radiation Monitoring System operated within the Ministry of Human Resources (OKSER IK).

### 16.1.3 The National Nuclear Emergency Response Plan

*The Hungarian Atomic Energy Authority operates a High Level Working Group consisting of the state administration organizations concerned for the regular review of the National Nuclear Emergency Preparedness and Response Plan (OBEIT).*

*The High Level Working Group revised the OBEIT again at the end of 2012 and renewed the OBEIT taking into consideration the legaslative changes. In order to improve the use of the plan, certain chapters and annexes have been removed from the OBEIT and appear as separate guidelines or expert aid. The list of guidelines published to date:*

- *Legal basis of the OBEIT*
- *Critical tasks of the National Nuclear Emergency Preparedness System*
- *Evaluation of critical tasks of the National Nuclear Emergency Preparedness System*
- *Organized help in defence*
- *Structure and operation of the National Radiation Monitoring, Control and Notification System*
- *Accident monitoring strategy*
- *Planning work of the organizations participating in the National Nuclear Emergency Preparedness System*
- *Development and continuous maintenance of nuclear emergency response plans*
- *Preparation, execution and evaluation of nuclear emergency exercises*
- *Decision-making with reference to, introduction and implementation of urgent protective actions*
- *Local management of radiological emergencies*
- *Organization of treatment of radiation injuries*

### 16.1.4 Nuclear emergency response system of the nuclear power plant

The emergency preparedness of the plant matches the National Nuclear Emergency Response System; its framework is laid down in the Comprehensive Emergency Response Plan.

One starting point to the preparation for emergency situations is the system of emergency classification, which is a pre-defined set of technological and radiation protection criteria, and which characterizes the severity of an emergency situation. The classification of an emergency situation entails the implementation of predefined measures. Classification enhances the uniform international and domestic understanding of severity and response to the impact of the emergency.

In emergency, the actions determined upon the declaration of the emergency class shall be introduced or shall prepare for their introduction in zones designated by concentric circles around the installation. Among the planning zones, the smallest in radius (3 km) is the “precautionary action zone”, in which the measures shall be prepared for in advance and implemented without undue delay in emergency. This circle is surrounded by the next, “urgent protective action zone” (30 km) and then the largest one (300 km), the “zone of restriction of foodstuff consumption” is located. Concerning the latter two zones (to be more accurate the Hungarian parts of the 300 km), specific laws determine the intervention levels, taking account of which shall be provided for determining the protective actions to be introduced.

Evaluation of radiological conditions is supported by the on-line, real time computer simulator of the NPP, which calculates the expected and averted doses by taking the environmental radiation and meteorological data into consideration.

*The 30 km urgent protective action zones of foreign nuclear power plants located near the country borders do not affect Hungary. Within the 300 km protective actions zone of food consumption restrictions, the same legally determined intervention levels shall be applied as for the similar planning zone of Paks Nuclear Power Plant.*

### 16.1.5 Comprehensive Emergency Management Plan of Paks Nuclear Power Plant

The main document of emergency preparedness in the power plant is the Comprehensive Emergency Management Plan. The structure of the plan is modular; besides regulation of the general emergency operation it contains different modules for different types of emergencies, such as nuclear emergency, general disaster, fire and civil emergency. The plan contains organizational and technical measures aimed at the assessment, limitation and management of emergencies.

Based on the assessment of emergencies, it lays down the current emergency class, defines the procedure of emergency management and control, the composition and operation of the Emergency Response Organization of the nuclear power plant, and the emergency responsibilities of particular individuals. Emergency tasks and necessary tools and resources are specified in emergency response scenarios. An alerting system ensures the rapid activation of the Emergency Response Organization of the plant.

The plan stipulates the order of internal and external alerts and communication and the method of operation and control of the necessary telecommunication devices. The protection of personnel, i.e. registering their whereabouts, arranging their rescue, dealing with the method of their protection and their decontamination, is regulated in detail. The plan also includes a list of materials and technical equipment used for emergency response. The detailed regulation of the prescribed tasks is contained in the modules and in the related procedures and implementation instructions of the plan. The plan also sets out regulations concerning the preparation, training, and exercises of the personnel.

The Comprehensive Emergency Management Plan is regularly revised and modified based on experience obtained in practice and according to changes introduced in domestic and international requirements.

### 16.1.6 Preparation and exercises

On-site and off-site exercises, including national and international exercises, are organized regularly in accordance with long term and annual plans.

As a member state of the OECD Nuclear Energy Agency, Hungary regularly takes part in the INEX international nuclear emergency exercises. Similarly, Hungary is a regular participant of the CONVEX nuclear emergency response exercises organized by the International Atomic Energy Agency and also participates in the exercises organized within the framework of the ECURIE system of the European Union.

The HAEA Emergency Response Organization takes part in the following type of exercises:

- alerting exercises to test the availability of the organization;
- methodological exercises for one of the groups of the organization without the other participants to drill the emergency tasks based on a specific emergency scenario;
- full scope exercises to inspect the performance of the whole HAEA Emergency Response Organization;
- internal communication exercises and international communication exercises initiated by the European Commission and bilateral countries.

The whole personnel of the plant shall be prepared for emergency tasks. The members of the emergency response organization are regularly trained for their specific tasks. The plant performs the exercises according to the annual training and exercise plan approved by the Authority. Types of exercises are grouped according to their objective (practicing or testing), participation (complex, management or partial) and to type of initiation (announced or unannounced). During the preparation of complex and management exercises, the plant communicates with the off-site emergency organizations to facilitate the cooperation.

The individual organizations hold partial exercises independently of the central emergency management. The sectoral emergency response plans also set out the order of communication test to inspect the availability and reliability of the contact points.

## 16.2 Information for the public and neighbouring countries

### 16.2.1 System of public information in a nuclear emergency; media relations

In emergency the alarm process is carried out with the help of the civil defence organization and the public media. An acoustic alarm and information system is operated by the National Directorate General for Disaster Management in the 30 km radius of the nuclear power plant. 227 modern public alarm and information devices operate in 74 settlements. The acoustic heads have local uninterrupted power supply, thus they are still operable in case of short circuit. The high power sound emitters are applicable to broadcast voice besides siren signals. The system may be launched upon the order of the chair person of the general assembly of the three counties concerned from the Protected Management Post of the plant, from the plant management centre, from mobile equipment and from the duty service of the Tolna county Disaster Management Directorate. In emergency, it is the duty of the national public media to provide appropriate information, but the power plant is also ready and prepared to issue press releases and to notify the public via the media, i.e. through local and nation-wide radio, television and the press, in agreement with the Authority. As a means of providing rapid information, mayors of settlements located in the vicinity of Paks NPP and the authorities involved in the emergency response receive SMS notification as well on the related events of the plant.

Supported by MVM Paks NPP Ltd, itself, municipalities located around the NPP have established the so-called Association for Social Control and Information. This organization ensures a more direct link between the plant and the settlements involved, and it also serves for information and preparation of the public for emergency situations. It supplies regular information about emergency preparedness activities of Paks NPP based on links with national media.

*Regarding emergencies occurring near the Hungarian borders, the central organizations of the national emergency response system, based on the information received from the partner authorities would inform the public about the emergency and the actions to be taken during the emergency.*

### 16.2.2 International relations

International conventions

The Republic of Hungary was among the first nations to sign the following multilateral conventions concluded in 1986:

- the Convention on early notification of a nuclear emergency;
- the Convention on assistance in the case of a nuclear accident or radiological emergency.

In order to prepare for the implementation of the convention on assistance in the case of a nuclear accident or radiological emergency the International Atomic Energy Agency established the international Response Assistance Network and the corresponding database, which contains the available assistance capabilities (such as field survey of contaminated area, appropriate treatment of radiation injuries, local professional support) of the member states.

The following parties are appeared in the database of the International Atomic Energy Agency: HAS Institute for Energy Research, Ministry of Foreign Affairs, Hungarian Atomic Energy Authority, National Directorate General for Disaster Management, Hungarian Meteorological Service, National Research Institute for Radiobiology and Radiohygiene, Paks Nuclear Power Plant. Laboratory capabilities, measurement devices and radiation protection and nuclear expertise were offered for assistance by Hungary with the stipulation that the conditions for providing the actual assistance shall be specified by Hungary on a case-by-case manner.

Hungary, as a Member State to the Vienna Convention, signed the Joint Protocol relating to the Application of the Vienna Convention on Civil Liability for Nuclear Damage and the Paris Convention on Civil Nuclear Liability in 1990.

In 1991, Hungary agreed to utilize the International Nuclear Event Scale (INES), which was introduced by the International Atomic Energy Agency.

Hungary is an active participant of the regional harmonization project related to emergency preparedness and response launched by the International Atomic Energy Agency. This project provided significant assistance to the revision and renewal of the National Nuclear Emergency Response Plan.

Hungary is member of the European Community Urgent Radiological Information Exchange (ECURIE) system, in the framework of which the accident country shall provide direct notification to the European Commission and the affected member states.

The European Commission awarded the RESPEC (Radiological Emergency Support Project for the European Commission) tender to the HAEA. In the project running from April 1, 2007 (till 2016 by winning the tender published again in 2012 June) the HAEA Emergency Response Organisation shall provide technical support to the European Commission in nuclear or radiological emergencies affecting or threatening the European Union and during the emergency exercises serving the preparation for such situations. The support covers the registration and hand over of technical data of nuclear installations, analysis of the situation, evaluation of atmospheric dispersion of a release, the recommendations on the introduction of protective actions related to foodstuff restrictions and public information.

<u>Bilateral inter-governmental agreements</u>

Bilateral agreements have been concluded with the following countries in the areas of early notification, mutual provision of information, and co-operation: Austria (1987); the Czech Republic (1991); Slovakia (1991); the German Federal Republic (1991); Slovenia (1995); Romania (1997); Ukraine (1997) and Croatia (2000).

<u>International data exchange</u>

Hungary pursues bi-lateral radiation data exchange with Austria, Croatia, Slovenia and Slovakia. Beyond that data is also forwarded to the European Radiological Data Exchange Platform (EURDEP). Data exchange is managed by the Nuclear Emergency Information and Evaluation Centre operated in the National Directorate General for Disaster Management.

The National Directorate General for Disaster Management represented Hungary in the EURANOS (European approach to nuclear and radiological emergency management and rehabilitation strategies) project aimed at uniting the developments related to nuclear and radiological emergency management. The key element of the project was a demonstration activity, the essence of which was to test the new methods and tools developed in the project at such locations where they are intended to be used in the future.

*Based upon the Austrian-Hungarian bilateral agreement, a piece of modern high-sensitivity radiation monitoring equipment was installed in Gerjen, in Tolna County.* The station also has a meteorological measuring system and provides data every half hour to the Nuclear Emergency Information and Evaluation Centre of the National Directorate General for Disaster Management. Most of the data of the station appears in a display located in the Mayoral Office of Gerjen and is also accessible via internet.

At the same time, the National Directorate General for Disaster Management also monitors the radiation data obtained from the 10 similar measuring stations of Austria and is provided with access to the background data display system of the Austrian State Centre for Early Notification.

*The extension of Mochovce Nuclear Power Plant in the territory of the Slovak Republic is in progress, which initiated further development of the radiological data exchange existing between the two countries in the following areas:*

- *transfer of data of radiological monitoring stations in the vicinity of the Mochovce NPP to the Hungarian data exchange centre;*
- *permission for the Hungarian disaster management organizations to install and operate three radiological remote measurement stations in Slovakian territory between Mochovce NPP and the national border;*
- *mutual exchange of measurement data of aerosol measurement stations operated by the Austrian government within the territory of Hungary and Slovakia.*

# D. THE SAFETY OF INSTALLATIONS

## 17. Site selection

**Nuclear Safety Convention, Article 17**
Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented:

(i) for evaluating all relevant site-related factors likely to affect the safety of a nuclear installation for its projected lifetime;

(ii) for evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment;

(iii) for re-evaluating as necessary all relevant factors referred to in sub-paragraphs (i) and (ii) so as to ensure the continued safety acceptability of the nuclear installation;

(iv) for consulting Contracting Parties in the vicinity of a proposed nuclear installation insofar as they are likely to be affected by that installation and, upon request, providing the necessary information to such Contracting Parties in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation.

### 17.1. Site characteristics

#### 17.1.1 Location and surroundings of the site

Paks NPP is situated about 115 km south of Budapest. The nuclear power plant is situated 5 km to the south of the town of Paks, 1 km to the west of the River Danube and 1.5 km to the east of National Main Road No. 6. Its geographical co-ordinates are 46°34'24" (northern latitude) and 18o54’53” (eastern longitude). The area of the site is 585 ha, it is the property of MVM Paks Nuclear Power Plant Ltd, and there is an additional 68 ha that has been appropriated for the purposes of potential extension. The site is used exclusively for activities related to the generation of nuclear energy.

The technological components may be delivered to the power plant by road, rail or water.

Detailed evaluation of the site from meteorological, hydrological and geological aspects is included in Annex 3.

#### 17.1.2 Public, external man-made hazards

About 200 000 persons live in the 30 km vicinity of the nuclear power plant.

The region is mainly characterized by cultivated land. The only industrial installation in the vicinity of the plant is the Spent Fuel Interim Storage Facility. This facility is independent of the plant; it has own Safety Analysis Report and as the licensee of the interim storage facility, the Public Limited Company for Radioactive Waste Management holds the operating license.

There is no airport (neither civil nor military), there are no take-off or landing safety zones or military establishments either in the near or wider vicinity of the power plant. According to regulations related to airspace usage, flights are permitted to cross the area in a radar-controlled airspace only above an altitude of 2,400 m above sea-level; while flying is completely prohibited within a 3-km zone around the power plant. Based on conservative estimates the probability of heavy transport or military aircraft crashing and falling on the plant onto the most sensitive area from safety point of view is under the regulated screening value ($1x10^{-7}$/year).

Analysis of road and waterway accidents during the transport of hazardous substances based on up-to-date statistics indicates that the probability of a release of hazardous substances that would reach the plant site and cause processes actually jeopardizing the safe shutdown of the units (e.g. poisoning or explosion) is under the regulated screening level.

## 18. Design and construction

**Nuclear Safety Convention, Article 18**
Each Contracting Party shall take the appropriate steps to ensure that:

(i) the design and construction of a nuclear installation provides for several reliable levels and methods of protection (defence in depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;

(ii) the technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;

(iii) the design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.

### 18.1 Requirements concerning design and construction in the Hungarian system of regulations

Volume 3 of the Nuclear Safety Code issued as an appendix to *Govt. Decree 118/2011. (VII.11.) Korm.* contains general nuclear safety-related requirements concerning the design of nuclear power plants. The requirements lay down in detail the principles and rules well known from international practice. The requirements reflect the most recent nuclear safety standards and stipulate in detail the principles being commensurate with the international practice.

#### 18.1.1 Application of defence-in-depth

The above regulation requires that the defence-in-depth principle shall apply to each safety related activity in such a way that any failure can be compensated for or corrected, and the occurrence of a severe accident situation can be prevented.

In addition, such specific supplementary systems, structures or components shall be provided for the protection of the public and the operating staff that are designed to mitigate the consequences of beyond design basis accidents.

#### 18.1.2 Application of proven and verified technologies

Equipment based on proven and verified technologies shall be available for the following functions:

- shut down the reactor safely and to maintain it in a safe shutdown condition in each operating state;
- removal of residual heat after reactor shutdown;
- reduction of release of radioactive materials and meeting of regulatory release limits.

The classified safety systems, structures and components shall meet the strictest applicable manufacturing, structural, inspection, maintenance and operational standards.

New design constructions are only acceptable for use provided that they are based on adequate research and development efforts. Before commissioning and during the service, all constructions shall be tested, paying special attention to new characteristics.

The scope of those safety-related systems, structures and components shall be determined which shall be designed to be inherently safe and/or as far as possible insensitive to any human error. The potential failure modes shall be identified, in support of which acknowledged probability analysis methods should be applied, where appropriate.

#### 18.1.3 Reliable, stable and easily manageable operation

In order to achieve a reliable, stable and easily manageable operation, the nuclear power plant regulations lay down, among others, the following principles in the fields of instrumentation, informatics and control engineering:

- Control and measuring instrumentation shall be installed in order to control safety parameters, systems, structures and components during normal operation, anticipated operational transients, and design basis accidents.
- An adequate communication system shall be established between different locations.
- The monitoring of operational parameters (important to safety and indicative of the condition of the plant) shall be ensured. Systems shall ensure the automatic registration and archiving of measurement data and instructions given to certain systems and components.
- Adequate control and regulating instruments shall be utilized in order to maintain the operational parameters, systems and components within the prescribed operational range.

Moreover, the regulations require the establishment of a unit control room, a back-up control room, and an emergency control room, and they also specify requirements to be considered for their construction.

### 18.2 Fulfilment of requirements at Paks Nuclear Power Plant

The design of units of Paks NPP was completed in two phases and was based on Soviet standards. When preparing the design bases, a strictly conservative engineering practice was used.

Paks NPP was designed in such a manner that during normal operation and in case of anticipated operational occurrences, the first three physical protective barriers (fuel pellets, fuel cladding and pressure boundary of the cooling circuit) must not be breached (thus the fourth barrier i.e. the containment inhibiting the release of radioactive substances had no function here). During those design basis accidents that were used for the design of the power plant, with a low probability of occurrence, the fuel matrix shall not be damaged or melted. However, to a certain extent the cladding of the fuel elements and the tightness of the primary circuit may be damaged, thus the containment function becomes necessary. The power plant was designed in such a way that as a consequence of design basis accidents the amount of radioactive substances released into the environment and the radiation dose of workers may not exceed corresponding health limits. Management of accidents that are more severe than design basis accidents but the probability of which are very low was not directly taken into account among the design principles of the units.

Elements of the defence-in-depth principle were accomplished in the nuclear power plant according to the requirements of Soviet standards.

Based on the experience gained from deterministic accident analyses, probabilistic safety analyses (level one and 2), severe accident analyses and on the summarized evaluation of all results, recommendations were made for safety improvement modifications and further complex analyses.

As a consequence of the implemented measures, the safety of the units was further increased; this is clearly revealed by the core damage probability data in chapter 6.1.3 and figure 6.1.3. According to the regulatory requirements the extension of the service lifetime of units is possible only if all planned safety improvement measures are completed, including the measures and modifications designed for management of potential severe accidents. *The required safety improvement actions and the actions designed for severe accident management have been accomplished in Unit 1, so the unit may operate for a further 20 years.*

## 19. Operation

**Nuclear Safety Convention, Article 19**
Each Contracting Party shall take the appropriate steps to ensure that:
(i) the initial authorization to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements;
(ii) operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation;
(iii) operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;

(iv) procedures are established for responding to anticipated operational occurrences and to accidents;
(v) necessary engineering and technical support in all safety-related fields is available throughout the lifetime of a nuclear installation;
(vi) incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body;
(vii) programmes to collect and analyze operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organizations and regulatory bodies;
(viii) the generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal.

## 19.1 Safety analyses

When Paks NPP was established and commissioned, Hungarian practices followed those accepted in developed countries. Based on the Technical Design provided by the supplier, a Pre-installation Safety Analysis Report was prepared, which was followed by the Preliminary Safety Analysis Report that was aimed at providing the basis for the Final Safety Analysis Report.

As time passed gradually more deficiencies were revealed in the Safety Analysis Reports when compared to Western requirements. For this reason, the safety of the power plant needed to be re-evaluated. The Hungarian Atomic Energy Commission launched the AGNES project in 1992 to reassess the safety of Paks NPP to bring it in line with standards of the 1990's. The AGNES project was concluded successfully at the beginning of 1995 and brought reassuring results, it did not revealed any major deficiency. Analyses of the first Periodic Safety Review performed for the units were based on the above results of the AGNES project with the addition of some other elements.

In the framework of PHARE projects, with the support of the European Union, in 2003 testing of the applicability of the accident localization system (confinement, bubble condensers) of the WWER-440/213 type units came to an end. The confinement used at the WWER-440/213 reactors of Paks NPP was proved to be adequate for design objectives; in other words, when a design basis accident takes place the environmental release can be managed within the regulatory limits.

Within the framework of the continuously developed and extended level-1 probabilistic safety analyses (PSA), probabilistic safety analysis concerning technological initiating events characteristic for full power and shutdown states, and also those concerning internal flooding, fire, high energy pipe ruptures and seismic initiating events have been completed. The value of core-damage frequency was calculated and sensitivity and uncertainty analyses were performed. All probable external effects jeopardizing safety were assessed.

*Probabilistic safety assessments of external hazards have been completed. According to the results of level-1 PSA the frequency of core damage, taking into consideration all operating states further taking account of the internal and external hazard factors and earthquakes, is under $10^{-4}$/year which is the limit specified for operational units.*

In order to determine the risk of a large radioactive release, a level-2 PSA containing all formerly analyzed operational states and initiating events was elaborated. In the framework of this analysis the load bearing capacity of the containment was determined for internal pressures occurring during severe accidents and significantly exceeding the design pressure.

Emergency calculations had earlier been made for the full scope of the design basis. The documentation of the Periodic Safety Review described the accepted methodology of analyses and also presented the results of the analyses that had been performed. The list of applied initiating events includes all events considered to be globally important plus the cases characteristic for WWER reactors. The most sophisticated and up to date computer programs were used for analyses.

All accident analyses were repeated at first to substantiate the elevated thermal power of the units, and then again to justify the acceptability of application of modernized fuel containing burn-up poisons.

Based on the deterministic analysis of basic accident scenarios performed within the framework of severe accident analyses, conclusions were drawn about processes inside the reactor and phenomena inside the containment, including the dispersion of radioactive materials. Based on the analyses the new accident management strategy and the scope of modifications necessary to implement it were determined. The Severe Accident Management Guidelines containing the new accident management strategy have been introduced in Unit 1 and 2; while the modifications necessary for the prevention, management of accidents and for consequence mitigation have also been implemented. A portion of the necessary modifications in Unit 3 and 4 have also been completed yet, while introduction of accident management and implementation of full scope of the modifications is planned for 2013 and 2014.

*In compliance with the latest international recommendations and the requirements of the European Union, the analyses of accidents in the extended design basis and demonstration of the meeting of the respective criteria have taken place, as well as the fact that the safety analysis of external hazard factors was achieved.*

The Final Safety Analysis Report shall be updated in line with the regulatory requirements. It is a living document, which follows and analyse the safety impact of different measures and modifications and evaluates safety performance according to international practice.

MVM Paks Nuclear Power Plant Ltd. reviewed the Final Safety Analysis Report in 2004. The aim of the work was to prepare such an advanced basic document which would serve as the basis for the licensing process for extending the lifetime of Paks Nuclear Power Plant. Extension of time limited ageing analyses required for supporting the extension of design lifetime is completed, while the renewed ageing management programmes have been commenced.

In accordance with the international expectations and European Union requirements the identification of initiating events belonging to the extended, beyond design basis was carried out. Analysis of beyond design basis cases and the concluding update of Final Safety Analysis Report is in progress, it will be completed till the end of 2010.

The plant submits regularly the updated Final Safety Analysis Report. The last version was sent in September 2012.

*The report contains the demonstration of compliance with the new Hungarian Nuclear Safety Code, developed and published in 2012, to establish the harmony of the international and Hungarian regulations. It also describes the analyses required for the 20 year service life extension of Unit 1. The update of the Final Safety Analysis Report demonstrating the compliance with the modifications of the requirements, which took place in 2012, shall be carried out during 2013.*

## 19.2 Operational limits and conditions

### 19.2.1 Technical Specifications

As the key element of the operating documentation the Technical Specifications, contain the operational limits and conditions of safe operation.

The operator shall maintain the document in up-to-date condition. Technical modifications of the plant, implementation of safety improvement measures, and technical modernization and scientific development may be introduced after regulatory approval.

## 19.3 Documents regulating operation

The quality management system of MVM Paks Nuclear Power Plant Ltd encompasses the regulations (codes, procedures), instructions (maintenance, handling, operation, inspection etc. instructions) relating to the processes necessary for operating the units, and the respective forms and records. The scope of regulating documents covers procedures to be followed during both normal, accident and emergency situations.

The procedures include action level regulations or, if it is justified due to the complexity or safety impact of the given action or it is stipulated by an individual requirement, the it may be regulated at instruction level corresponding directly to the activity within the specific process.

The valid version of each element of the regulation system is available in printed form for those participating directly in operation, and it is also downloadable from the INTRANET of the company. Information for the contractors should be provided as specified by the contracts. Process of entering into force, review, holding time and of withdrawal is regulated.

## 19.4 Emergency operating procedures

The plant began the development of the system of symptom-based operating procedures in 1996, the completed procedures were introduced in 2003 after validation on the plant simulator and after full training of the personnel.

Subsequent to the introduction of symptom-based operating procedures for power operation it is the objective of Paks Nuclear Power Plant to create such system of procedures that are built on each other and by the application of which the personnel can handle every operational incident and severe accident.

In order to achieve the above objective the whole system that had been introduced in 2003 was reviewed by the end of 2009. Accordingly, the shutdown symptom-based operating procedures for the non-power operation states and for the incidents of the spent fuel pool as well as the severe accident guidelines were completed.

*The procedures for non-power states were introduced in 2011 for all units. The introduction of severe accident management guidelines, unit-by-unit, shall be accomplished during the years 2011-2014 in accordance with the plans, following the implementation of the related technical modifications.*

## 19.5 Technical support

### 19.5.1 Maintenance

The maintenance organization of the nuclear power plant is divided into crafts (mechanical engineering, electrical and civil engineering) but each operates according to unified principles.

The system and implementation of maintenance and overhauls in details is described in Annex 4.

### 19.5.2 Technical background

<u>Technical and preparatory bodies</u>

In the present organizational system of Paks NPP, technical support is basically divided according to crafts. The safety function and responsibility of technical support is ensured through the following items:

- System analysis, condition monitoring, establishment and execution of technical tasks for safe and economical operation of the nuclear power plant based on the assessment of operational and maintenance events.

- Provisions ensuring that the units meet the actual technical and safety requirements by utilizing international nuclear energy industry results.
- Technical justification, planning and execution of safety improvement measures, modifications and investments.
- Condition monitoring, trend analysis, ageing management and lifetime management tasks in the technical engineering, electrical, instrumentation and control engineering, architecture and chemical engineering crafts, and execution of tasks and assessments serving for preserving the qualified state of equipment.
- Execution of technical and closely related safety and economical calculations, analyses and reviews.
- Technical design, preparation of technical applications to the Authority, maintenance of respective technical documentation.
- Preparation for archiving of technical documentation, and delivery of archive material to storage.
- Justification and preparation of technical developments (e.g. technical optimization, increase of efficiency, decommissioning).
- Preparation and licensing of operation beyond design lifetime, as a primary strategic objective of the company, company-level management and coordination of associated tasks.
- *Investment optimization using value analysis methodology*
- Operation of the company technical documentation system, technical documentation management, operation of document archives.
- Provision of key-data management activity for technical databases.
- Maintenance-technological justification, preparation, planning, licensing of maintenance and repair works, provision of their documentation, elaboration and licensing of maintenance, repair, assembly technologies and programmes.
- Work scheduling of planned preventive and periodic maintenance and repair activities.
- Recording, evaluation and feedback of maintenance experience, design and licensing of execution plans needed for maintenance, repair and trouble- shooting work.
- Development of medium- and long-term fuel consumption strategies.
- Planning of nuclear fuelling, fuel supply, stocking, and coordination of associated tasks. Supervision of safe operation of fuel.
- Development of medium, long-term and annual maintenance programmes of the company.
- Updating the cyclic maintenance plan of plant equipment.
- Draw up of company-level development and investment programme.

<u>Decision support committees</u>

Permanent or ad hoc committees may be set up to make recommendations concerning emerging tasks. The tasks and operation of such committees are specified by the entity establishing them. The most important committees are the *Technical Forum*, the Maintenance Working Committee and the Operation Monitoring Committee.

<u>Domestic and foreign support institutes</u>

The nuclear power plant maintains close relations with all Hungarian companies performing technical support for the plant. The power plant maintains relations with those foreign companies (or their successors) that have contributed to the design and construction of the plant or in the manufacturing of its equipment, e.g. TVEL, ATEP, Skoda and Hidropress.

*Based on contracts currently in force, the general design services are provided by MVM ERBE ENERGETIKA Engineering Ltd; while principal consultants are jointly the HAS Institute for Energy Research and NUBIKI Nuclear Safety Research Institute.*

## 19.6 Reports to the Authority

According to requirements concerning the Licensee's reporting obligation, two categories are to be distinguished:

### 19.6.1 Regular reports

- quarterly report: notifying the Authority of the operational history, current issues of operation and most important factors affecting operation;
- annual report: based on the quarterly reports, but upon the more information being available due to longer periods of time elapsed, a more comprehensive description, evaluation and analysis is available;
- annual safety report: the final safety analysis report should be updated by the Licensee according to the changes relating to nuclear safety taken place in the installation;
- *quarterly and annual reports on activities related to maintenance effectiveness monitoring: performance monitoring of systems and components fulfilling active functions, evaluation of their reliability and inoperability;*
- reports on overhaul and repair activities: concerning repair activities affecting safety and overhauls accompanied by refuelling;
- other information: providing the Authority with up-to-date information.

### 19.6.2 Event reports

- Events under the obligation of immediate reporting are required to be notified of within two hours following their occurrence; the INES classification of all events subject to reporting shall be performed, and the provisional rating shall be submitted to the Authority within 16 hours following the occurrence;
- all occurrences subject to reporting are to be submitted to the Authority in writing within 24 hours of their occurrence;
- an event-investigation report should be submitted to the Authority within 30 days of the occurrence of any event.

## 19.7 Feedback

### 19.7.1 Own operating experience

Data acquisition and processing became craft-specific as far as equipment and activities are concerned within the mechanical, instrumentation and control and electric engineering crafts. As a result of this, monitoring and the utilization of data received also differ in depth and complexity. A joint database from different crafts has been developed in order to ensure a uniform system of data acquisition and processing.

Analysis of reliability and availability indicators should be the basis of replacement, modernization or modification of components or equipment. These data are used in safety analyses as well. The power plant shows good indicators regarding safety systems even by international comparison. In order to achieve a unified and uniform system of data acquisition within the power plant, a plant-level regulatory framework has been prepared.

Safety-related events occurring at the power plant are investigated with the involvement of the entire technical staff. Events are investigated at different levels, which are intrinsically determined by the severity of the event. Events reported to the Authority are investigated at plant level, while other events are investigated at craft level. From 1992 onwards, events are classified according to the INES scale, and previous events were also classified retrospectively. Since 2000, several events have also been analysed by probabilistic methods.

During the period of 1992-2012 the safety related events that occurred at Paks Nuclear Power Plant were classified to INES as seen in figure 19.7.1. One INES-1 event took place in the subject period of this report (in 2012).

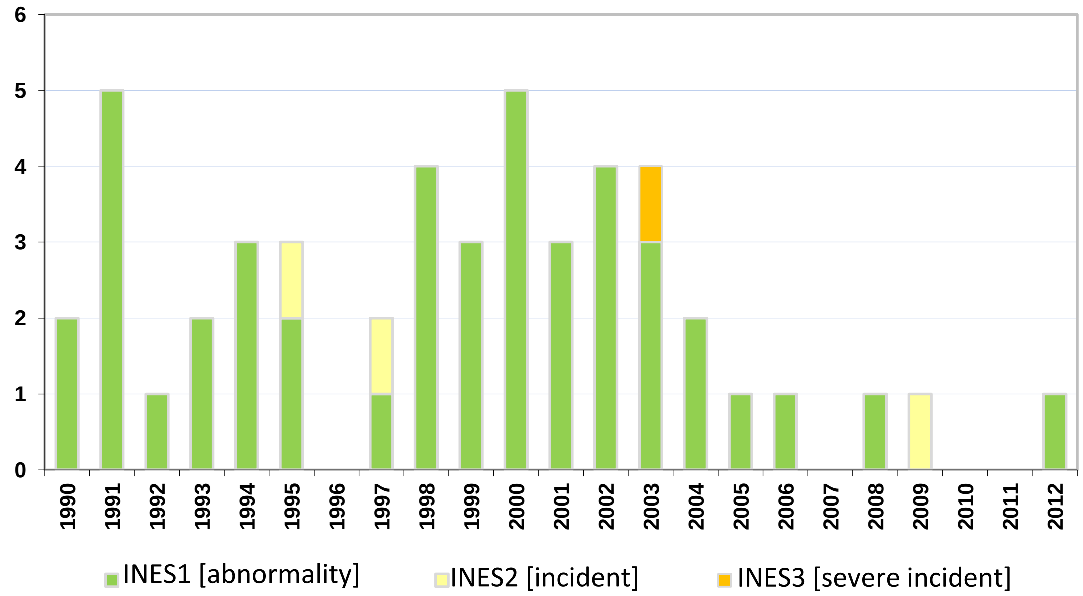



***Figure 19.7.1:*** *Number of INES 1, 2 and 3 events from 1990*

*The INES 1 event was the violation of an administrative limit of the Technical Specifications determining the safe operational limits and conditions of the units. The primary cooled water system performs safe and continuous cooling of some equipment. The sections of the system inside and outside of the hermetic compartments are separated in certain accident situations by way of three isolation valves in series. A licensed modification, planned by Paks NPP for the main outage, was performed later, during operation of the unit, on September 5, 2012. In this state it is required to have all the three valves operable. Although it was provided by way of other valves throughout the modification, so that the isolation safety function, which is the basis for the limitation was not violated, the exemption from the limitation was not requested by the Licensee. Therefore, due to the violation of the administrative limitation, the event was evaluated to be INES 1 (abnormality).*

The results of investigations and the corrective measures are widely presented. Responsible personnel and deadlines related to corrective measures are always defined and as such are always traceable. Not only single events but also trends are monitored, including the reliability of safety systems. Should any trends be revealed, modifications or other technical or administrative measures are carried out if needed. Experience gained from every event is used for educational purposes via simulator training. The permanent and regular revision of operating instructions and the Technical Specifications offers evidence of the feedback of operating experience.

Once every quarter, the Operation Control Committee reviews the safety indicators, the lessons learned from event investigations, and the status of accomplishment of all measures taken. The Operation Control Committee is an organization operated by the Safety Directorate; it places disputed issues on the agenda for consideration. The head of the Safety Directorate has the right of decision in this forum.

### 19.7.2 Feedback of experience of other power plants

It is of vital interest to Paks NPP to learn and make use of operating and other experience imparted by other installations and international information sources. MVM Paks Nuclear Power Plant Ltd takes part in the work of significant international nuclear organizations (e.g. International Atomic Energy Agency, OECD Nuclear Energy Agency). There exists closer co-operation by way of participating in the professional work of various groups comprising operators of nuclear power plants, such as the World Association of Nuclear Operators (WANO) and the Club of WWER-440 Operators. The closest cooperation may take place between the partner plants. Links such as these enable many kinds of mutually advantageous occasional or long-term activities to be identified, including joint projects, exchange of experiences, and data supply.

### 19.7.3 Reviews by external entities

The following table shows international reviews that were carried out at Paks Nuclear Power Plant.

**Table 19.7.3.** International safety reviews carried out at Paks Nuclear Power Plant

| Year | Subject of the review | Review performed by |
|---|---|---|
| 1984-1987 annually | Operation, maintenance | Experts invited by the Soviet supplier |
| 1988 | OSART (full scope) | IAEA |
| 1990 | Operation, maintenance | Experts from 4 countries invited by the power plant |
| 1991 | Design for safety | IVO |
| 1991 | Post-OSART review | IAEA |
| 1992 | Peer Review | WANO |
| 1992 | ASSET | IAEA |
| 1993-1996 | Site seismicity - 6 occasions;<br>seismic safety programme<br>– 2 occasions | IAEA |
| 1995 | Post-ASSET review | IAEA |
| 1995 | Peer Review follow-up | WANO |
| 1996 | Assessment of the accomplishment of safety improvement measures | IAEA |
| 1997 | Nuclear Liability Insurance Engineering Inspection | International experts of the insurance pool |
| 1997 | Quality assurance audit | Blayais Nuclear Power Plant |
| 1999 | PSA analysis of low power states (IPERS) (VEIKI-Paks NPP joint studies) | IAEA |
| 2000 | Pre-OSART mission | IAEA, Paks NPP |
| 2001 | OSART mission | IAEA |
| 2001 | Nuclear Liability Insurance Engineering Inspection | International experts of the insurance pool |
| 2003 | Review of Unit 2 event | IAEA |
| 2003 | Review of Unit 2 event | WANO |
| 2003 | Expert mission concerning the development of organizational operation | IAEA |
| 2004 | *Expert mission on organizational development* | *IAEA* |
| 2004 | *Follow-up mission of the serious incident that took place at Unit 2* | *WANO* |
| 2005 | *Follow-up missions of OSART and expert missions* | *IAEA* |
| 2005 | *Peer review* | *WANO* |
| 2008 | *Follow-up of peer review* | *WANO* |
| *2012* | *Peer Review* | *WANO* |

*The Moscow Centre of the World Association of Nuclear Operators (WANO) conducted a peer review for all 4 units of Paks Nuclear Power Plant between February 20 and March 2 2012. The review of the team, consisting of international professionals experienced in nuclear power plant operation, covered the whole scope of operating activities of the plant and the determination of areas for improvement and strength in the operational practice. Since the renewal process of the WANO, which had been launched based upon the experience gained from the Fukushima nuclear accident, this was the first peer review conducted by the Moscow Centre of WANO. During the review, the WANO professional team, with the support of the* *professionals designated for each area from the plant's staff, altogether 9 internationally remarkable good practice and 18 areas to be improved were identified. The latter areas are those, where places for improvement are identified in Paks Nuclear Power Plant taking into consideration international best practice. Based on the recommendations provided by the peer review Paks Nuclear Power Plant compiled its Action Plan and commenced its implementation.*

In conclusion it can be established that all of the safety reviews were terminated with positive general evaluation, however the experts gave several recommendations based on the international experience to further improve the safety performance. Implementation of action plans developed for the resolution of the issues plays a major role in increasing the level of safety.

It is the power plant`s intention to continue the practices followed to date and have the plant assessed by major international review teams in the future, at least every 3 years.

### 19.7.4 Radioactive wastes

On September 29, 1997 Hungary signed the joint convention established under the umbrella of the International Atomic Energy Agency on the safety of management of spent fuel and radioactive wastes, which was promulgated by Act LXXVI of 2001. A detailed discussion of the issues related to radioactive wastes and spent fuels can be found in the report submitted within the framework of the Convention; below only the most important characteristics are cited.

The classification of radioactive wastes takes place in accordance with Decree 47/2003. (VIII. 8.) ESZCSM of the minister responsible for health on certain issues of interim storage and final repository of radioactive wastes and radiation health issues of naturally occurring radioactive materials concentrating during industrial activities.

The safe handling of radioactive wastes of the nuclear power plant is the responsibility of the entity generating the waste, i.e. MVM Paks Nuclear Power Plant Ltd. The collection, processing and interim storage of wastes is part of the operating tasks; preparations for safe final disposal are being made within the framework of a national project.

According to the Act on Atomic Energy and its executive decrees the responsible organization for *final* disposal of radioactive wastes and for interim storage and final disposal of spent fuel, *closing of the nuclear fuel cycle* together with the de-commissioning of nuclear facilities is the Public Limited Company for Radioactive Waste Management. Legally, waste generating entities are obliged to create financial resources for waste disposal and decommissioning by payments into the Central Nuclear Financial Fund. This Fund also serves to cover the activities aimed at the final disposal of radioactive wastes, namely preparatory works and assessments. The administrator of the Central Nuclear Financial Fund is the Hungarian Atomic Energy Authority; the Fund itself is disposed by the minister supervising the Hungarian Atomic Energy Authority.

**Activities aimed at supporting the final disposal of low and medium level radioactive waste from the nuclear power plant**

From 1983 to 1997 low level solid wastes generated by the power plant were transported to Püspökszilágy (30 km away from Budapest), within the framework of a contract concluded with the approval of the Authority. Since 1997, solid radioactive wastes from the power plant have not been transported to the above-mentioned site. Till the end of 2004 the original capacity of the storage facility had been exhausted. *Based on the safety analysis performed in 2002 a comprehensive safety improvement programme was launched. In the frame of that, and as a result of the reclassification and repeated processing of the waste disposed of, additional capacity of several years are released for the disposal of non power plant radioactive wastes on the site.*

*The demonstration part of the safety improvement programme was successfully completed in 2010, during which removal, selection, processing and re-disposal of the wastes of 4 storage pools took place. Based upon the experience, the detailed plan of continuation of the safety improvement programme was developed. In parallel with the preparatory works corresponding to this project, a physical protection modernization project was also launched.*

Relying on the results of surveys and safety analyses of several years to select the subsurface repository site for low and medium level radioactive wastes of nuclear power plant origin, the vicinity of Bátaapáti was selected. Based on the resolution in principle of the Parliament and the positive result of the local referendum the establishment of the National Radioactive Waste Repository commenced in 2006.

In the first phase of the establishment, by the autumn of 2008, the most important surface facilities of the National Radioactive Waste Repository were completed, and the commissioning license was granted by the competent authority on September 25, 2008. By this achievement the interim storage of low and medium level waste of Paks Nuclear Power Plant preceding the final disposal became possible, at least in respect of some portion of radioactive wastes (altogether 3000 barrels of 200 l).

*The tunnels surrounding the underground repository chambers were completed by the beginning of 2010. Construction work of the surface of the tunnels was finished during 2011 and the first two chambers became ready to accept the waste. The competent authority granted the operation license for the surface facility and the first chamber of the National Radioactive Waste Repository, which came into force on September 21, 2012.*

*The first reinforced concrete container containing 9 waste barrels was placed in the facility in December, 2012.*

**<u>Preparatory work for the final disposal of high level radioactive waste</u>**

The Boda aleurolit formation in the Western Mecsek Mountains seems to be potentially suitable for the disposal of long lived radioactive wastes of high activity level and the spent fuel assemblies (not regarded as radioactive waste according to the present regulation) generated in Hungarian nuclear facilities.

A research programme aiming at the site selection for high level radioactive waste started in 2003. The implementation, however, slowed down in 2005 so as to give priority to the construction of the National Radioactive Waste Repository for low and medium level radioactive wastes.

*In 2010, by way of the completion of a final report, the first part of the surface research was completed, although with a reduced scope as compared to the original plans. After the professional and methodological review of the results obtained to date the research plan for the next part of surface research was developed in 2012.*

*In planning of the subsequent phases of the comprehensive research programme, lasting until the construction*, which shall take into account the service life extension of Paks Nuclear Power Plant and the new international trends and results emerged recently with regard to closure of the fuel cycle.

***Amount of waste stored on December 31, 2012***

*The amount of low and medium level solid radioactive waste in the nuclear power plant is altogether 9825 barrels of 200 litres.*

*The amount of liquid waste stored in the plant in the radioactive waste storage barrels is 8060 $m^3$, which consists of evaporation residue, decontamination solution, ion exchanger resin along with transport water and evaporator acidifying solution.*

*Up to December 31, 2012 45.8 $m^3$ of high level radioactive waste was generated altogether, the required disposal volume of which is 73.3 $m^3$.*

## 20. Plans on safety improvement

This chapter summarizes safety improvement plans and measures to be implemented.

As a consequence of the Fukushima nuclear accident on March 11, 2011, Paks Nuclear Power Plant carried out a Targeted Safety Reassessment. The Authority approved the report resulted from the reassessment and, at the beginning of 2012, required the Licensee to implement the safety improvement actions decided by the plant. The implementation of the safety improvement plan is to be conducted in two phases, until 2015 and until 2018. The safety improvement actions decided upon the Targeted Safety Reassessment makes the management of severe accidents affecting more units (or spent fuel pools) at the same time possible. The most important actions are as follows:

- *a) purchase of high power accident diesel generators protected against beyond design basis external hazards;*
- *b) implementation of containment overpressure protection occurring during severe accident;*
- *c) construction of alternate cooling of the spent fuel pools;*
- *d) construction of a Protected Command Centre and a Backup Command Centre protected against beyond design basis external hazards;*
- *e) construction of alternate water supply possibilities by taking into account all coolant resources nearby the site (bank filtered wells, fishing lakes, water discharge (hot water) canal, tanker truck supply);*
- *f) improvement of reliability of electric power supply from an external network;*
- *g) development of a severe accident simulator.*

# ANNEX 1: DETAILED DESCRIPTION OF IN-SERVICE INSPECTIONS

**Types of operational tests**

The preparation, scheduling, performance, evaluation and documentation of tests and inspections performed regularly or in an ad hoc manner on systems, sub-systems and components of the nuclear power plant are regulated by the instruction of MVM Paks Nuclear Power Plant Ltd.

On the basis of the instruction, the processes and activities related to tests are regulated in the following classification:

- in-service technological test – this is a function for testing systems in standby state of operation while by the lowest risk possible;
- unit shutdown technological test – this checks the operability of components and systems taking part in the shutdown, and obtains information for maintenance work;
- overhaul technological test – this enables one to check the operability and function of components and systems maintained during overhaul;
- unit start-up technological test – this is a full-scope test following maintenance;
- non-scheduled technological test – this is a full-scope or partial testing that is necessary for verifying operability.

**Scheduling of in-service tests**

The tests in the first step are scheduled on an annual basis, the annual time schedule is prepared by considering the cycle times of tests. For the branches of multiple, redundant systems, tests are scheduled for different times. Specific dates and times of the performance of tests are decided upon at weekly planning meetings, when the operational status of the unit and the permissible deviation in cycle times are already known. Those tests prescribed in the Technical Specifications are planned from overhaul to overhaul. With these in mind, the allowed cycle time difference is ±4 days.

**Evaluation of in-service tests**

The records evaluating the tests are the basic documents for verifying acceptability. Evaluation is done by the organization responsible for the performance of the test. As a result of the evaluation the maintenance, reconstruction, quality management concepts and cycle times may be modified.

All records of operational technological tests have been kept by the power plant since 1992 and they have been processed carefully.

Over a period of time the in-service tests performed have verified the adequate availability of components, structures and systems and means of protection. In some cases, supplementary measures had to be taken as a result of an unsuccessful test, but the operational safety of the units has never been jeopardized, and no unit has ever been shut down for this reason.

**Tests related to overhauls**

During overhauls three groups of tests are performed:

- before shutting down the unit, tests are scheduled to verify the systems necessary for shutdown and cooling;
- during the overhaul of the unit, upon completion of the maintenance of safety systems, the adequacy of these are tested before handing over the next system for maintenance;
- after the overhaul of the unit, the systems necessary for start-up and operation of the unit are thoroughly tested.

Tests are scheduled depending on technological conditions. The sequence of tests and the conditions for establishing further operational states are regulated.

Among the above listed groups the one performed after the unit overhaul contains the most tests. These are the following:

- functional and interlock tests of individual components;
- tightness and pressure testing of systems;
- full logical and real functional testing of protection systems;
- hydraulic pressure test of the main cooling circuit and of steam generators, depending on cycle times;
- integral tightness test of the hermetic zone;
- criticality tests on the reactor, in order to verify the physical calculations;
- unit star up tests performed at different power levels.

The scope of tests to be performed after weekend maintenance is decided after special consideration, when the nature of interventions and the time elapsed are already known.

Introduction of electronic testing instructions in relation to extension of service lifetime means a significant change in the system of tests. The essence of the method is that the testing process is supervised by the unit computer, thus information occurring during the test is recorded, and the subjectivity about measuring of valve running times is eliminated. The application of the method means important contribution also to the frequency test of rotating machines. Data of electronic testing instruction may be processed within the system of origin and can be uploaded to the central database where, as lifecycle data, may be analysed further. *Data obtained from the system forms the basis of development for a symptom-based maintenance strategy.*

**System of requirements relating to material testing**

In Paks NPP, the unified programme and criteria for periodic material testing were elaborated simultaneously with the commissioning of the units and on the basis of Soviet requirements and standards, pre-commissioning tests and international experience, and with the involvement of domestic research institutes.

These requirements were approved by the National Energetics and Energy Safety Engineering Inspectorate, competent at that time, and any modification requires the permission of the Authority. During the preparation for the service life extension of the units these documents were revised according to modern requirements. The documents are revised regularly and necessary changes are made.

*The Nuclear Safety Code issued as Annex to Govt. Decree 118/2011. (VII. 11.) Korm. on the nuclear safety requirements for nuclear facilities and on the corresponding regulatory proceedings* requires the in-service inspection of nuclear power plant components. *It stipulates that the Licensee shall develop and implement a documented in-service inspection programme in relation to systems, structures and components important to nuclear safety to demonstrate the integrity of the aforementioned systems, structures and components and determine the actions necessary to maintain the safe conditions.*

**In-service inspection**

The scope of in-service inspection is defined by material testing programmes, which specify the testing area, the method of testing, the scope and frequency of testing, reference to the corresponding item of the acceptance standards, technological conditions needed for the test, engineering safety requirements and the anticipated method of documentation for each component element or group of components. The full-scope periodic and non-destructive material testing of primary and secondary circuit equipment comprises the following units:

- reactor and its sealing units;
- upper chamber;
- reactor internals;
- main circulating pipeline;
- steam generators;
- pressurizer;
- hydro-accumulators;
- primary circuit components and piping;
- local sealing;
- secondary circuit components and piping;
- clamping structures;
- fuel containers.

The criteria for the evaluation of tests are contained in the volume entitled "General Methodology and Acceptance Standards for Non-Destructive Material Testing".

## ANNEX 2: AGEING MANAGEMENT

**Basic concepts of ageing management**

The nuclear power plant meets the regulatory requirements related to ageing management, which enables the plant operator to create the safe conditions for operation of the plant even beyond the design lifetime (30 years). This concept is in accordance with

- international (mainly US) and domestic experience related to ageing and lifetime management;
- the aspects of nuclear safety;
- the continuous development of scientific and technical knowledge.

MVM Paks Nuclear Power Plant Ltd. conducts a systematic lifetime management activity for the components of safety classes 1-3, and for those that do not belong to safety class but whose failure may jeopardize the operation of components providing a safety function. According to the concept:

- The technical conditions of the required safety level for components fulfilling an active function is ensured by utilizing the maintenance effectiveness monitoring system;
- Environmental qualification is made for electrical and I&C components operating under harsh environments, and the qualified state is continuously maintained;
- Systematic ageing management is conducted for components fulfilling passive function: (1) individually for critical components, (2) in groups for other components (component groups).

The systematic ageing management in relation to components fulfilling passive function includes consists of:

- determination of postulated degradation mechanisms and ageing sensitive locations;
- application of measures mitigating and preventing ageing mechanisms;
- determination of parameters to be inspected for ageing monitoring;
- timely detection of ageing effects by operational and in-service condition testing (e.g. technical safety reviews, non-destructive material testing, operational tests.);
- monitoring of aged condition (ageing monitoring system), status evaluation;
- development of acceptance criteria used for status evaluation;
- development and implementation of corrective measures for non-compliances (e.g. repair, replacement, administrative measures);
- improvement of efficiency of component ageing management programme (feedback of condition information into the programme);
- possibility of administrative verification regarding ageing management (quality management, coordination, documentation);
- utilization of operational experience feedback.

*These activities are performed in approx. 150 ageing management programmes, the technical aspects and contents of which are in compliance with the Hungarian requirements and, additionally with the international practice (US NRC NUREG 1801, International Atomic Energy Agency Safety Guide NS-G-2.12).*

**Selection of critical components**

The components screened for ageing management were selected primarily during the review of equipment. These components play a prominent role in the cooling and safe shutdown of the reactor core, and of structures inhibiting the release of radioactive substances (principle of defence-in-depth). During the selection procedure, the document *Technical Report Series 338 of the International Atomic Energy Agency entitled "Methodology for the Management of Ageing of Nuclear Power Plant Components Important to Safety"* together with the related Hungarian regulations in the Nuclear Safety Code issued as Annex to Govt. Decree 118/2011. (VII. 11.) Korm.

As a consequence of taking the above aspects into account the plant performs systematic ageing management with regard to passive components in safety classes 1-3 (about *25,000 items/unit*). The components covered by the ageing management programme belong to one of the following groups:

(1) *Items listed in the Nuclear Safety Code as critical components. Ageing management of each of these components is performed individually.*

(2) Components managed on system component group (commodity group) level. Several components aged similarly belong to the same group.

The set of critical components is the same, the items of which need long term lifetime management activity or the replacement of which would mean serious financial and technical challenge. The critical components are as follows:

- reactor pressure vessel;
- reactor pressure vessel internals;
- reactor pressure vessel supporting structure;
- reactor control rod drive mechanisms;
- nozzles of main circulating loop and the connected pipelines;
- pressurizer;
- steam generators;
- main gate valves;
- main circulating pumps;
- seismic reinforcement of main components.

*Regarding the other mechanical components and civil structures, the plant may decide if it performs ageing management in commodity groups or by way of an individual ageing management programme. Regarding electric instrumentation and control components operated in a harsh environment, the plant shall perform equipment qualification.*

**Procedures**

*The plant implements comprehensive ageing management as required by the Nuclear Safety Code. Examination of technical issues related to systems, structures and components, determination of ageing management related tasks, implementation of the comprehensive ageing management and operation of specific ageing management programmes are based on the procedure "Operation of ageing management programmes". The procedures specify and harmonize the tasks of the organizational units involved in the implementation of ageing management.*

**Current status of ageing management**

Taking account of the differences the ageing management in the plant is carried out within the four crafts: mechanical, electric, I&C and civil engineering. The systematic and coordinated activity is ensured by the respective procedures.

Component-specific ageing management programmes have been developed by the crafts, based on which the implementation of the comprehensive ageing management is performed. Electric craft is an exception, where ageing management of cables according to specific programmes are only the supplements of environmental qualification. During the development of specific ageing management programmes the formerly applied condition monitoring programmes and results had been used.

Results of ageing management are of major significance in the licensing process of lifetime extension in the determination of the technical and safety margins of important equipment and in the development and implementation of lifetime management strategy. Ageing management utilizes the domestic and international good practices and results. New, previously not known degradation processes may arise during the work, for the learning of which the targeted research and development might assist.

## ANNEX 3: SITE EVALUATION OF PAKS NUCLEAR POWER PLANT

**Meteorology**

Based on the measurements performed at Paks, the annual mean temperature is slightly increasing. The length of extremely cold periods (25 °C below zero) spans a few days only. Experience shows that the nuclear power plant is able to prevent the freezing of components caused by such cold weather by taking temporary measures. It is often the Paks meteorological station that report the most intensive night cooling in the entire country, as the sandy soil of the region allows strong heat emission, thus the microclimatic layer cools down more easily on clear nights. No specific tendencies can be found regarding maximum temperatures.

Distribution of precipitation shows great variation, and this is obviously caused by the proximity of the River Danube.

The dominant wind direction is north-westerly though surveys have found that north-easterly winds are becoming more predominant during winter. No significant new trends have been found concerning wind speeds.

Other effects (e.g. hurricanes, extraordinary rain or snow) are so rare in the region that they were not even taken into account when the plant was designed. *Protection against external natural hazards has been completed. The administrative and technical actions intended to manage the deficiencies have mostly been completed.*

Since the installation of the nuclear power plant, weather conditions have proved to be rather capricious within the range of values characteristic for Hungary's climatic zone, but it cannot be shown that the plant has had any effect on the microclimate. For the time being, climatic changes have not affected the safe operation of the nuclear power plant.

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**Hydrology**

In the vicinity of the site the only significant surface water is the River Danube, which is of slightly low-course nature here. The power plant is situated at 1,527 river km from the mouth of the Danube. The Danube is well regulated in the region.

The average yield of the river in the region is 2350 $m^3/s$, the water speed is 1m/s, the average height of the water is 88 m above Baltic Sea level.

The quantities of warmed cooling water discharged into the Danube from the power plant are as significant as the amounts of heat flows that determine the natural heat balance of the river, thus the natural river water may become heat polluted under unfavourable conditions. If all four units are in operation during autumn, some 10 to 11% of the total yield of the river has to be removed for cooling. The plume of hot water returned to the river completely mixes on its way to the border of the country (some 80 km), but no obvious temperature rise can be measured after the midway of this section. According to Decree 15/2001. (VI . 6.) KöM of the minister responsible for environment and the water use license issued jointly for the four units, the warming of the cooling water returned to the river may not exceed 11 °C, or 14 °C if the temperature of the water is below 4 °C. The cooling water temperature is continuously measured by the Licensee; the limit has never been exceeded. The maximum temperature of the hot water stream must not exceed 30 °C at a distance of 500 m from the point of entry. This parameter is randomly checked by the competent authority, the measured values have never exceeded the set limits. To date, the temperature of discharged water has never consistently reached these limit values.

By comparison with previous data, the water quality has improved. This can be explained by the fact that industrial and agricultural production have fallen back both in Hungary and in certain neighbouring countries where our river waters mostly originate.

Statistical analyses of floods with different probabilities of occurrence have assessed the differences between icy and ice-free conditions of high water levels. The flood level with a probability of $10^{-4}$/year (0.01%) is 96.36 mB (above the Baltic Sea) as calculated for icy waters and 95.62 mB as calculated for ice-free waters. Floods usually begin at the 93.3 mB water-level, and the frequency of this does not even reach 1 day/year (0.18 day). The landfill level of the power plant site has been defined at 97.00 mB; this level is 40 cm higher than the formation level of the flood-control dike in the vicinity of the power plant, and 24 cm higher than the highest water-level calculated to occur once every 10,000 years.

**Assessment by earth sciences**

Geology, tectonics

Geological research has shown that there are three main groups of formations in the geological composition of the region: pleistocene-holocene surface sediments, neogene basin sediments, and the paleozoic-mezozoic basin basement.

Seismic-tectonic characteristics

The final evaluation of the seismicity of the site was elaborated with the help of experts of the International Atomic Energy Agency and accepted by the Authority. The value considered in original design was 6 on the MSK scale based on the catalogue of historical earthquakes in Hungary and on the isoseistic map that can be drawn from this. Seismicity is low in Hungary as a whole, even though stronger vibrations (with epicentre intensities of about 8 on the MSK scale) do occur, they are few in number. These are rather unevenly distributed regionally. Based on the frequency of seismic disturbances in the time period from the middle of the 19th century to the present day, a quake of intensity 4 on the MSK scale can be expected once a year while one of intensity 8 (MSK scale) may occur once every 40 to 50 years. Relations between known tectonic elements and available seismologic data can be shown only in certain cases. The focal depth of quakes in Hungary is usually 9 to 12 km, and the quakes are usually of the strike-slip nature.

The characteristics of an SL-2 earthquake (maximum horizontal acceleration, uniform hazard response spectra) were determined by calculation using probabilistic seismic hazard analysis based on a 10,000 year repetition rate. Calculation of free-field characteristics has taken into account the non-linear transmission of upper loose soil layers. Input for these calculations was taken from the results of the site geo-technical study programme. For maximum free field horizontal acceleration of an SL-2 earthquake a value of 0.25 g has been accepted.

On the seismic profiles taken at the site and its surroundings, several fault lines can be observed in the Pannon layer, which suggest movements 6 million years ago. Based on the data obtained it can be presumed that the fault lines generally follow the W-SW → E-NE direction, while a few of them follow the SW→NE direction. At the same time none of the profiles of the minimum 45,000 year old Quaternary upper layer had fault lines. Detailed geological and geophysical analyses performed at the site and its surroundings show that there is no obvious sign of a Quaternary fault. No Pannon structure can be related to measurable activity. No Quaternary faults can be found in the loess to the west of the site either. Deterministic analyses showed no faults reaching the surface. In spite of this, low-probability activity of structures within the Pannon layers around the Paks site was taken into consideration in the probabilistic risk analysis.

Joint evaluation of data of micro-seismic monitoring put into operation in 1995 and that from the recent neo-tectonical scientific results was performed in 1998. These studies justified that the assumptions taken as the basis for the evaluation of site seismicity and for analysis of the present activities were correct; there is no need for their revision. Microseismic monitoring is being continued by Paks Nuclear Power Plant Ltd and the results are annually published for scientific purposes.

Soil liquefaction

The basis for the assessment of soil liquefaction was a detailed geotechnical analysis of the site, following the recommendations of the International Atomic Energy Agency (50-SG-S9). The upper soil layer (about 30 m) at the site is young river-water with sandy, gritty, loose sediment with a shear wave speed of 250 to 355 m/s. This covers the Pannon layer of around a minimum 500 m/s shear wave speed. The quality of the soil meets the requirements for foundations.

On the areas not exposed to the pressure at the base of buildings, the probability of soil liquefaction is less than $10^{-4}$/year, thus in the case of a maximum design basis earthquake with a probability of $10^{-4}$/year, no soil liquefaction can be expected.

## ANNEX 4: MAINTENANCE *AND INSPECTIONS*

The maintenance of the power plant aims at ensuring a high technical standard of equipment and the nuclear safety thereof; and to maintain its operability through reasonable expenditure. The key element of the maintenance system is that of being well planned *with optimal realization of preventive maintenance and condition dependent maintenance. Certain components may operate until failure, this is also part of the maintenance strategy.*

General overhauls consist of the following activities:

- technical and safety reviews implemented within the In-service Inspection Programmes;
- periodic and individual maintenance works;
- inspections laid down by material testing frame programmes;
- work prescribed by the authorities;
- repairing failures occurred during operation;
- safety improvement measures, modifications, reconstructions.

Periodic maintenance work performed on units in operation is accomplished on equipment with sufficient backup that can thus be handed over during the rated operation of the given unit. This reduces the work to be done at overhauls.

Regular maintenance circles serve as means of assessing the condition of operating equipment or those in stand-by mode. *Maintenance or repair of equipment is scheduled on the basis of the potentially revealed deficiencies*.

*Preparation is a key element of maintenance, which is the task of the centralized technical organization. Such a task is, for example, the management of the activities of preventive maintenance programme in the work management system and compilation and updating of the documentation describing the operation history of the equipment.*

**Overhaul strategy**

One of the most important factors affecting the availability of the power plant is the time required for overhauls. Recently, considerable efforts have been made to optimize or, if possible, decrease this time period.

The long-term strategy is aimed at implementing a series of measures that can reduce the time taken by overhauls to an optimal level both from the aspect of economic efficiency and the adequate use of the workforce.

*A new element is the "interim overhaul" within that unit, where the inspection cycle has been changed to 8 years in relation to mechanical components of safety class 1.*

- *Short overhaul: works to be performed cyclically, and repair of spontaneous failures.*
- *Interim overhaul: fuel loading and unloading, barrel removal, internal inspections of main gate valves and valve revision that can be implemented at low reactor level.*
- *Long overhaul: fuel loading and unloading, inspection of reactor pressure vessel and vessel internals, internal inspections of main gate valves and valve revision that can be implemented at low reactor level, hydrostatic pressure test of steam generators (interim overhaul can be implemented if necessary).*

**The order of executing maintenance activities**

*The activities of maintenance, as a main process of the plant, are regulated under the production subsystem and the hierarchically subordinated process instructions and procedures. These documents include:*

- *the systems and components in question and their parts;*
- *maintenance related preparatory activities;*
- *the activities to be performed;*
- *documentation, evaluation and experience feedback of maintenance activities;*
- *materials used directly or indirectly during the activities.*

*Corresponding to maintenance, quality supervision activities are performed in accordance with regulating documents of main processes of inspection and industrial safety.*

The system of requirements ensures that all activities corresponding to civil, electrical, instrumentation and control and mechanical engineering related maintenance of the power plant are of adequate quality. Several kinds of supervising methods and regulation guarantee were introduced at Paks NPP.

Compliance with quality requirements is inspected during maintenance supervision and quality control activities; in some cases HAEA staff also inspects the activities.

*The basic documents of maintenance work are the work instructions, maintenance instructions and the corresponding quality control plan, technical decision sheet, along with the maintenance records, plans, technology descriptions and permits.*

*The procedure for the scheduling of major and minorl overhauls includes all tasks related to documentation and specifies the responsible personnel. The management body of the overhaul scheduling is the Maintenance Working Committee. Its work is regulated by conference rules. The implementation of the overhaul is determined by the overhaul authorization plan, the overhaul net diagram, and other directives in force.*

Separate instructions regulate the planning and accomplishment of planned preventive and periodic maintenance work. The lowest level of maintenance regulation consists of several hundred equipment-specific maintenance technologies.

The method of involving external contractors in maintenance is also regulated in detail. External contractors are involved in order to accomplish individual tasks on the grounds of classical service contracts. *The factors ensuring supervised work are: the contract, the authorization of the applied technology, the system of work instructions, the handing-over of the working area, and the obligatory inspection exercised by executives of the given professional area.*

# ANNEX 5: ENFORCEMENT POLICY OF THE HAEA

The main elements of the enforcement policy of the Hungarian Atomic Energy Authority are as follows:

- Compliance with the conditions set out in the obligatory requirements; compliance with its actions - in harmony with international practice, assessment of the problems based on safety significance.
- It is expected that the effective regulations be followed on a voluntary basis by everyone concerned; based on this assumption the HAEA expects voluntary and independent revealing, reporting, and correction of any possible deviations from requirements. The HAEA`s enforcement activities relate to those cases deviating from this approach.
- The policy declares that the goal is to support the efficient prevention and the introduction of the possible earliest actions, with enforcement, if necessary. Detailed aspects and are given in the procedure.
- Enforcement is strictly realized within the framework of the legal background, and does not extend to other occurrences that may take place despite careful prevention activities.
- Enforcement measures are necessary only after establishment of the infringement of requirements if compliance with the obligations could not be achieved without such intervention, or would be subject to delay, or the severity of occurrences demands explicit sanctions to prevent any recurrence.
- When the urgency and severity of regulatory enforcement actions are justified, at first the direct impact of infringements related to safety are assessed, and secondly their potential future impact on safety shall be assessed.

Implementation of the enforcement policy is regulated by a procedure. The procedure relies on the general rules of public administration procedures. The procedure also addresses the situation when the violation of more obligations exists; when they are necessary, expedient or possible to be assessed in the framework of one procedure; and how the resultant safety significance of more infringements can be determined. The procedure discusses in detail against what standards and according to what aspects it is necessary to assess the safety significance of the violation of a prescription. The basis for assessment of severity is the safety classification of the system or equipment to which the violation corresponds and the type of requirement breached. Before its introduction the comments of MVM Paks Nuclear Power Plant Ltd., as the largest Licensee, was sought in connection with the elaborated procedure.

*The maximum fine is determined by Govt. Decree 112/2011. (VII. 4.) Korm.* The fine shall be at least 50,000 HUF, but shall not exceed

- 50,000,000 HUF for the licensee of the nuclear power plant in nuclear safety cases,
- 5,000,000 for the licensee of other nuclear facilities.

It is extremely important that the fine is only one of the tools of law enforcement. Other tools to be used before or together with fining:

- warning of the license and call upon to correct a non-compliance or infringement, setting a fair deadline;
- order of obligations with deadline;
- limit the operating conditions;
- limit the validity of the license;
- revoking of the license.

The law enforcement procedure was developed in 2002 and has been used ever since. There were three cases when fines have been imposed since the entering into force of the enforcement procedure.

There were three more cases when the procedure was initiated, but the case was terminated without imposing a fine after clarification of the facts:

*The Authority did not impose fines on the nuclear facilities between 2009 and 2012, but utilised the other legal instruments of law enforcement listed above.*

## ANNEX 6: ACTIVITY AIMED AT EXTENDING PAKS NPP OPERATION

***Preliminaries***

*The owner of Paks Nuclear Power Plant declared, as a strategic goal in 2001, to extend the original design lifetime of 30 years of the units 1-4 by an additional 20 years, following a study of service life extension and its economic feasibility. This strategic goal, after the specification of necessary tasks and preparatory works, was confirmed by an assembly resolution of the owner, based on which MVM Paks Nuclear Power Plant Ltd launched the project aimed at the founding and licensing of the service life extension. In the frame of the service life extension project, the Licensee performed the two major tasks for licensing: it prepared and founded the environmental license application for service life extension and elaborated and founded the programme with the intention of creating the conditions for the planned service life extension.*

*The HAEA has verified the programme and its attached documentation, and has not identified any such deficiency which would have excluded the possibility of service life extension. The HAEA supplemented the elements/tasks of the service life extension programme by specifying additional requirements in its resolution and, in a separate resolution, specified additional tasks that were not directly related to the preparation of service life extension but were revealed during the review of the programme.*

***Activities in the service life extension project between 2010 and 2013***

*The implementation of the Service Life Extension Programme started under the coordination of the Service Life Extension Implementation Project from 2010. The programme contained the tasks decided by the plant, supplemented by the Authority, other tasks planned in other technical fields to create the conditions for the service life extension and tasks related to modification of technical practice of the limited company. The implementation project lasts from 2010 until the new license for operation of unit 4 scheduled in 2017 is obtained.*

*The Authority decides on licensing of service life extension of the units based on the assessment of license applications to be submitted for each unit. It shall be described in the license application that the programme introduced in the service life extension documents and assessed and supplemented by the Authority has been successfully finished by Paks Nuclear Power Plant and that it has prepared the given unit for the operation during the extended lifetime. The design lifetime of Unit 1 of Paks Nuclear Power Plant expired at the end of 2012 and the plant therefore submitted the application for extending the service lifetime to the HAEA on December 5, 2011.*

*During 2012, the implementation of the tasks of the service life extension program continued. The tasks consisted of activities to finish some of those not yet completed in relation to Unit 1 but, considering that the license application shall be submitted for unit 2 by December 2013 at the latest, the preparatory tasks for this were more and more important.*

*As part of licensing, the nuclear authority held a public hearing on October 4, 2012 in Paks, in which the employees of the plant also actively participated. Thanks to the extraordinary efforts during the preparation, the public hearing took place without any problems. MVM Paks Nuclear Power Plant, at the request of the HAEA, has prepared a summary for the public.*

*Beyond that, it was also an important task in 2012 to update the Final Safety Analysis Report in accordance with the requirements for service life extension, which was completed by the deadline.*

*After considering all these issues, on December 17, 2012 the Hungarian Atomic Energy Authority granted the operating license for Unit 1 of Paks Nuclear Power Plant for the period from January 1, 2013 to December 31, 2032.*

***Additional tasks from the operation license of Unit 1***

*Most of the conditions and tasks in the regulatory resolution on service life extension are general, not directly related to the service life extension. For example, such are the limitations on the reactor thermal power, stipulations on the release limits or the paragraphs describing the reporting obligations. These are meant to continue the former practice for the extended service life.*

*There are some requirements however, that directly address the service life issue: particular material testing tasks, completion of some modifications and further calculations, analyses and evaluation which are set out as the basis for further operation.*

***License of the Hungarian Energy Authority***

*The license of the HAEA issued on December 17, 2012 on the service life extension of Unit 1 of Paks Nuclear Power Plant is a legal reason, according to Govt. Decree 273/2007. (X.19.) Korm. about the implementation of certain orders of the Act LXXXVI of 2007 for modifying the electric power production operation license of Paks Nuclear Power Plant. Accordingly, Paks Nuclear Power Plant has applied for a new electric power production operation license. The Hungarian Energy Authority has granted the license.*

## ANNEX 7: LIST OF LAWS

I. Acts

| | |
|---|---|
| Act IV of 1978, then (from 02.07.2013) Act C of 2012. | on Penal Code |
| Act CXVI 1996 | on Atomic Energy |
| Act I 1997 | on the promulgation of the Convention on Nuclear Safety concluded in Vienna on the 20th of September in 1994 under the umbrella of the International Atomic Energy Authority |
| Act CXL of 2004 | General Rules of Administrative Proceedings and Services |
| Act LXXXII of 2006 | on the promulgation of safeguards agreement and protocol on the implementation of Article III, (1) and (4) of the Treaty on the Non-Proliferation of Nuclear Weapons, and on the Additional Protocol enclosed to the Agreement. |
| Act LXII of 2008 | Publishing Amendments to the Convention on the Physical Protection of Nuclear Material, Adopted by the International Atomic Energy Agency (IAEA) in 1979 and Published by Legal Decree 8 of 1987, Signed on 8 July 2005 at the Diplomatic Conference Organised by the IAEA |
| *Act XLIII of 2010* | *on central state administrative organs and on the legal status of government members and state secretaries* |
| *Act CXXVIII of 2011* | *on disaster management and amendment of certain corresponding acts* |
| *Act I of 2012* | *on Labour Code* |

II. Government Decrees

| | |
|---|---|
| Govt. Decree 275/2002. (XII. 21.) Korm. | on the monitoring of radiation levels and radioactivity concentrations in Hungary |
| *Govt. Decree 314/2005. (XII. 25.) Korm. rendelet* | *on environmental impact study and licensing procedure of unified environmental use* |
| Govt. Decree 136/2008. (V. 16.) Korm. | on promulgation of first modification of Espoo Convention on Environmental Impact Assessment in a Transboundary Context of the UNO approved on February 17, 2001 in Sofia and of its second modification approved in Cavtat on June 4, 2004 |
| Govt. Decree 179/2008. (VII. 5.) Korm. | on the promulgation of the agreement on support and financing of repatriation of spent fuel of the Budapest Research Reactor concluded between the Government of the United States of America and the Government of Hungary |
| Govt. Decree 204/2008. (VIII.19.) Korm. | on the promulgation of the agreement on cooperation regarding repatriation of spent fuel of the Budapest Research Reactor concluded between the Government of the Russian Federation and the Government of Hungary |
| Govt. Decree 34/2009. (II. 20.) Korm. | on licensing of transboundary shipment of radioactive wastes and spent fuels |
| Govt. Decree *167/2010. (V.11.) Korm.* | *on the National Nuclear Emergency Response System* |
| *Govt. Decree 323/2010. (XII. 27.) Korm.* | *on the National Public Health and Medical Officer Service, on fulfilment of public health administration tasks, and on the designation of pharmaceutical administration organ* |
| *Govt. Decree 112/2011. (VII. 4.) Korm.* | *on the scope of activities of the Hungarian Atomic Energy Authority in connection with its international obligations including the European Union, its authority and penalizing rights, the assignments of its co-authorities and on the Scientific Committee assisting the HAEA`s activity.*<br>*(Regulation for establishing an authorization system, responsibilities of the operator, inspection and enforcement)* |
| *Govt. Decree 118/2011. (VII. 11.) Korm.* | *on the nuclear safety requirements for nuclear facilities and the procedures of the Hungarian Atomic Energy Authority in nuclear safety regulatory matters* |
| *Govt. Decree 190/2011. (IX. 19.) Korm.* | *on physical protection requirements for various applications of atomic energy and the corresponding system of licensing, reporting and inspection* |
| *Govt. Decree 234/2011. (XI. 10.) Korm.* | *on implementation of Act CXXVIII of 2011 on disaster management and amendment of certain corresponding acts* |
| *Govt. Decree 246/2011. (XI. 24.) Korm.* | *on safety perimeter of nuclear installation and radioactive waste repository* |
| *Govt. Decree 247/2011. (XI. 25.) Korm.* | *on independent technical expert proceeding in nuclear energy issues* |

III. Ministerial decrees

| | |
|---|---|
| Decree 16/2000. (VI. 8.) EüM of minister of health | on the execution of certain provisions of the Act CXVI of 1996 on Atomic Energy |
| Decree 15/2001.(VI. 6) KöM of minister of Environment | on radioactive discharges to air and water during the use of atomic energy and its control |
| Decree 47/2003. (VIII. 8.) ESzCsM decree of minister of health, social affairs and family | on certain issues of interim storage and final disposal of radioactive wastes, and on certain radiohygiene issues of naturally occurring radioactive materials concentrating during industrial activity |
| Decree 7/2007. (III. 6.) IRM of minister of justice and law enforcement | on the rules of accountancy for and control of nuclear material |
| Decree 19/2007. (VIII. 29.) ÖTM of minister of Local Authorities and Rural Development | on specific fire protection rules for use of atomic energy and on the enforcement of the rules by the authorities |
| *Decree 47/2012. (X. 4.) BM of minister of interior* | *police tasks corresponding to the use of atomic energy* |
| *Decree 55/2012. (IX. 17.) NFM of minister of national development* | *on special professional and further education of employees of nuclear installations, and on the scope of professionals authorized to perform activities corresponding to use of atomic energy* |

## ANNEX 8: *NATIONAL ACTION PLAN OF HUNGARY ON THE IMPLEMENTATION ACTIONS DECIDED UPON LESSONS LEARNED FROM THE FUKUSHIMA DAIICHI ACCIDENT*

*The annex contains the description of actions ordered in Hungary based on the experiences gained from the Fukushima accident in the same form as it was submitted to the European Commission by Hungary.*

*Accordingly the information in the annex is unchanged, including its own title page, internal table of contents and page numbering.*

# National Action Plan of Hungary

## on the implementation actions decided upon the lessons learned from the Fukushima Daiichi accident

**Compiled by**
**Working Group of the Hungarian Atomic Energy Authority**
**for the European Commission**

**Hungarian Atomic Energy Authority**
**Budapest, December 2012.**

| | Name, assignment | Signature | Date |
|---|---|---|---|
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## Introduction

The accident at the TEPCO Fukushima Daiichi NPP triggered the European Council to conclude that the safety of all EU nuclear power plants should be reviewed, on the basis of comprehensive and transparent risk and safety assessment [1] - the so called stress tests. The official Hungarian denomination of this assessment was "Targeted Safety Re-assessment" (TSR). The stress tests consisted of three main steps: a self-assessment by licensees, followed by an independent review of the results and preparation of a national report by the national authorities, and by a third phase of international peer reviews. The peer review also consisted of 3 steps: an initial desktop review of the national reports, three topical reviews in parallel *(namely: external initiating events, loss of electrical supply and of ultimate heat sink, and accident management)* when the reviewers discussed the national reports with the authors of the reports; then visits were conducted by international expert groups at the national authorities and at the site of one nuclear power plant in each of the 17 participating States concerned. This last phase meant the conclusion of the country reports.

In Hungary, the Hungarian Atomic Energy Authority (hereinafter referred to as the HAEA or the authority) issued the requirements for operator's re-assessment [2] shortly after the publication of the ENSREG requirements [1]. The nuclear power plant completed the re-assessment and then the Authority prepared and submitted the national report [3] to the European Council by the deadline.

As the result of the first two steps of the international peer-review, draft country reports were drawn up on the basis of the reports of the national authorities and the consultations. These draft country reports still contained a "list of open questions" requiring further discussion, which provided basis for the third review phase to be concluded on the scene. The Hungarian party provided the review team with further information regarding the open questions even before the commencement of the third review step. During the visit phase, the review team conducted a site walk-down in addition to discussions with the experts of the authority and the operator. In the course of the site visit the international experts received clarification and explanatory information and visited the locations, reviewed equipment as well as the relevant procedures, which were referred in the National Report [3].

The international peer-review concluded that Hungary submitted a comprehensive National Report [3], which presented the appropriate analyses and their results. Hungary provided further detailed answers and explanations to the questions asked during the presentation of the report. During the national review both the authority and the operator provided appropriate explanations and justifications, as well as they allowed the international experts to observe the relevant documentation. The peer-review team was allowed to visit all relevant locations during the site walk-down.

The general statements of the country report on Hungary [5] on the basis of international peer-review were:

- The nuclear power plant is in compliance with the licensing conditions, able to withstand the loads induced by a design basis earthquake, flood or by extreme weather conditions; additionally, the facility is prepared for those design basis events, which entail the total loss of the electric power supply or the ultimate heat sink.
- The design basis established during the construction of the plant was extended through a series of safety improvement programmes (e.g. free surface acceleration, occurrence frequency of external threats) during the service life of the plant.
- Regulatory requirements were not in existence for events beyond the design basis at the time of the construction of the plant, but they are now established and the plant is in compliance with them thanks to the completed modifications.

- As a condition for the planned service life extension the authority requested the completion of all modifications in connection with the management of severe accidents. (These modifications had already been completed on Unit 1, since the service life extension licensing procedure of this unit finishes in 2012).

In addition to those mentioned above, in the course of the TSR process the operator proposed several corrective actions in order to increase the safety margins [3]. The HAEA overviewed and accepted the proposed actions and, together with a few additional actions, issued a decision [10] on their implementation and the preparation of a detailed implementation action plan.

The actions to be implemented for increasing the margins require detailed analyses and further preparation. Consequently, the authority required the preparation of the above mentioned action plan, which includes the detailed description of each action, the schedules of their planned implementation and the final deadlines thereof. This action plan [11] was submitted by the operator for regulatory review on June 27, 2012. The authority, after careful review, ordered the implementation of the actions in an authority resolution [12] on December 17th 2012. The operator's action plan [11] determined a list of elementary actions in order to complete the actions identified in the National Report [3] and in the authority decision [10], so that each elementary action can be associated with a unique modification or some other activity. Therefore, the number of elementary actions is larger than the number of actions in the authority decision [10], without identifying any new action since. In the current National Action Plan we refer to these elementary actions and also to additional actions to be completed by the authority itself.

After the implementation of all corrective actions, the authority shares the opinion of the operator on the judgment of the safety improvement of the nuclear power plant, as follows:

- The occurrence probability of severe accidents due to the permanent loss of electric power supply and ultimate heat sink is decreased.
- Severe accidents of reactors and spent fuel pools can be prevented or mitigated by the provision of an alternative water supply and electric supply routes.
- Extreme external events may cause damages to the site, but the risk of damage occurrence and the consequences of such events are reduced.
- The capability to prevent and/or mitigate accidents simultaneously affecting more units is enhanced.
- The solutions that can be utilized for emergency response are extended, including accident situations simultaneously affecting more than one unit.

The European Union has not closed the European level review triggered by the accident of Units 1-4 of the TEPCO Fukushima Daiichi Nuclear Power Plant; instead it declared its intention to track the implementation of the actions decided on the results of the "stress tests" in the Member States. Accordingly, the ENSREG (European Nuclear Safety Regulators Group) as the advisory body of the European Council made a decision at its meeting held on September 4-5, 2012 that the EU Member States operating nuclear power plants should elaborate a National Action Plan (hereinafter referred to as NAcP) and then submit it to the European Council by December 31, 2012. The NAcP should include the corrective actions identified during the stress tests and the subsequent international review, together with the deadlines for their implementation. Additionally, the NAcP should include the actions determined in the scope of those issues, which were identified in the 2nd Extraordinary Review Meeting of the Convention on Nuclear Safety (CNS) held in August, 2012.

The ENSREG provided guidance for the format and content of the NAcP (i.e., "Compilation of recommendations and suggestions, Peer review of stress tests performed on European nuclear power plants" [9] and "National Action Plan (NAcP) Guidance as directed within the ENSREG Stress test Action Plan" [8]). The current Hungarian NAcP has been prepared in accordance with these recommendations in the following structure and with the following content:

The introduction describes in general the preliminaries, the structure of the NAcP and the authority tasks in connection with the implementation of the corrective actions.

Part I, in line with the ENSREG recommendations [9] in its Topics 1-3, discusses the actions determined in relation to:

- natural hazards,
- loss of safety systems,
- severe accident management.

The document includes a short description of the actions, but their detailed justification is excluded, since such information can be found in the publicly available TSR National Report [3].

Part II includes those statements and potentially required actions, which came to the floor only at the Extraordinary Review Meeting of the Convention on Nuclear Safety held in Vienna, on August 27-31, 2012. Hungary, pursuant to the expectations, submitted an Extraordinary National Report [6] to the Convention by the requested deadline. The main areas discussed during the extraordinary review meeting, in addition to the scope defined by ENSREG, were:

- National organizations,
- Off-site Emergency Preparedness and Response,
- International Cooperation.

Part III would list those actions, which were not discussed above and did not belong to any areas listed above. Such actions were not identified based on the review; so Part III remained blank.

Part IV presents the actions discussed in Parts I-III in a table format, together with the deadlines for their implementation. In order to facilitate the identification of the listed actions, the table, if appropriate, provides references to the identifiers used in the ENSREG recommendations [8, 9], to the related chapters in the TSR National Report [3], as well as in the authority resolution [12] ordering their implementation. These references are meant to facilitate the work of those reviewing the NAcP, since the corrective actions can be clearly associated with the previously identified lessons and issue areas to be assessed.

This Hungarian NAcP was thus prepared based on the authority resolution [12] issued on the action plan proposed by the licensee of the nuclear power plant [11] (in relation to the scope and deadlines of tasks to be performed by the licensee) that was complemented by the actions to be performed by the authority.

## *Authority tasks*

The authority, during the implementation of actions decided based on the lessons learned from the Fukushima accident, performed and performs the following tasks:

a) Review of the TSR action plan prepared by the licensee [11], its extension and harmonization, as well as ordering its execution.
b) Authority supervision of the execution of the ordered action plan; oversight of the fulfilment of the action plan.
c) Revision of the nuclear safety legal requirements, with the consideration of the compulsory requirements of the EU directive and of the reviewed WENRA reference levels and also of the reviewed IAEA safety standards, as well as the results of the national review process of the legal background.
d) Participation in the international processing and utilization of operational experience feed-back (IAEA and ENSREG Action Plan, OECD NEA).
e) Public information.

*a) Review of the road map of the licensee*

The authority evaluated the action plan submitted by the licensee [11]. A working group was established to carry out the evaluation, which prepared a work plan including the major milestones and viewpoints of the review. The review was carried out by at least two experts in each professional area and task, based on whether:

- the harmony with the TSR [3] report is adequate,
- all findings identified in the TSR report are managed,
- the actions are adequate and effective to eliminate the findings,
- the actions established are clear and can be performed,
- the schedule of actions is justified, and the safety risk of the period until the implementation is acceptable,
- the tasks have any relationship to Service Life Extension or Periodic Safety Review results (in order to establish agreement among action plans).

In the course of the review described above, the HAEA requested the licensee to supplement the action plan in order to comprehensively evaluate the safety risks of the periods remaining until the execution of each action. After the review of the additional information provided by the licensee, a unified and synthetic plan was concluded, the implementation of which was ordered by the authority to be carried out by the operator [12].

*b) Supervision of the implementation of the licensee's action plan*

The execution of tasks listed in the action plan, even if the shortest possible deadlines are considered, is a long-lasting process, which needs several years. Consequently, the authority should be prepared for a long-term supervisory activity, which may include difficulties that are usual in the case of actions requiring such prolonged implementation periods (e.g. replacement of persons, difficulties in traceability).

The supervision over the execution of actions can be divided to two basic groups:

A.) The supervisory activities for (nuclear safety related) modifications requiring authority apporval are to be performed in line with Govt. decree 118/2011. (VII.11) Korm.; i.e. licensing procedure, inspection and evaluation in connection with the given modification, and if appropriate, enforcement. The modifications not requiring authority approval are also inspected and evaluated by the authority. The oversight can be performed by a site inspection during the construction phase or via evaluation of the relevant documentation.

B.) Supervisory activities of actions not related to any modification (e.g. study, analysis, assessment, concept planning) are performed through evaluation of the individual documents in order to ensure that the necessary interventions will be accomplished in compliance with the nuclear safety requirements. If additional actions are to be established based on the regulatory evaluation (e.g. further modifications are needed), then the supervisory activities are realized as in Para A.

The progress of the implementation of the licensee's action plan is supervised by the authority in the frame of comprehensive and targeted inspections. These inspections are integrated to the yearly inspection plan of the authority.

In order to facilitate the tracking process of the implementation of the action plan, the authority obliged [12] the licensee to prepare periodic (due every six months) reports. This regulatory tool was applied by the authority also for tracking the action plan that was established as a result of the latest Periodic Safety Review. The TSR action progress report should present the progress in the implementation of each action individually, including the difficulties, decision points, any change in the schedule, as well as any such issue that may have effect on implementation. The report should also identify the reference documents prepared for each action.

*c) Review of nuclear safety laws*

The nuclear safety requirements for nuclear facilities should be reviewed based on the lessons learned from the Fukushima accident, as discussed in detail in Topic 4 of Part II.

*d) Participation in the international experience feedback*

Several international organizations are committed to process the experience gained from the Fukushima accident. HAEA has an active role in the work of these organizations, what gives opportunity to exchange and utilize the lessons learned (see Topic 6 of Part II).

In summary, the most important task in the field of international cooperation is the preparation and execution of the National Action Plan (NAcP).

*e) Public information*

It is important to inform the public about the results and consequences of the Hungarian and European stress tests. The HAEA puts special emphasis on providing appropriate and correct information to the public, as further discussed in Part II.

# Part I: Review areas derived from the Post-Fukushima Stress Tests of the European Union

Part I contains the Action Plan concluded in the three main topics (1: Natural Hazards, 2: Loss of Safety Systems, 3: Severe Accident Management) of the Targeted Safety Re-assessment (the Hungarian stress test), which has been structured according to the expectations of the four following documents:

1. ENSREG "Compilation of Recommendations and Suggestions" [9],
2. Stress Test Peer Review, Country Report about Hungary [5],
3. Recommendations of the 2nd Extraordinary Meeting of the Contracting Parties to the Convention of Nuclear Safety held in 2012 august [7], and
4. additional tasks revealed during the Hungarian Stress Test [3].

According to the three main topics Part I is divided into three chapters, in which four sub-chapters appear.

# Topic 1: Natural hazards

The accident of Fukushima Daiichi NPP has made it obvious that it is essential to consider the *appropriate* level of natural hazard factors in the design basis of nuclear power plants and that in addition to direct impacts the indirect consequences should also be taken into account.

## *1.1 Tasks derived based on the ENSREG "Compilation of Recommendations and Suggestions" document [9]*

Document [9] highlights eight topics in relation to external natural hazards in Sections 3.1.1. through 3.1.8., which should be covered in the National Action Plans (NAcPs). Those issue groups regarding these topics together with the respective tasks are described below in which corrective actions were decided to improve the situation:

### *1.1.1 Recurrence frequency taken into account in the design basis*

According to the recommendation: *in the safety reviews and back-fitting of nuclear power plants a return frequency of $10^{-4}$ per annum (0.1g minimum peak ground acceleration for earthquakes) with respect to external hazards should be considered.* The Hungarian regulation requires to consider natural hazards of 10 thousand year recurring frequency. As described in Section 2.1.1. of the Hungarian Stress Test Report [3] this requirement had been satisfied for earthquakes before the Periodic Safety Review terminated in 2008, due to the completion of the seismic safety reinforcements. The respective analyses demonstrated (See [3] 3.1) that the requirement for flooding, or for low water level, of the Danube is also met. ([3] 4.1.). Systematic assessment of these impacts had not yet been accomplished at the time of the Periodic Safety Review, but later, by 2011 December the analyses were successfully completed. [<1>][1]. So no open task exists in this relation.

### *1.1.2 Secondary effects of earthquakes*

The assessments described in Section 2.3.3. and 3.1.1 of [3] showed that flooding occurring as a consequence of an earthquake on the site, or far from it (dam break in upstream direction or narrowing of runway of the Danube), cannot endanger the site. Possible secondary effects of design basis earthquakes are discussed in Section 2.1.2. of [3]. However, occurrence of a fire on the site cannot be excluded, which may necessitate the deployment of the plant fire brigade. Some intervention is necessary therefore to protect the personnel and equipment in

[1] The form [<x>] will be used hereinafter to make reference to individual serial number of tasks listed in Part IV.

the fire brigade headquarters, which are made of reinforced concrete, but are not yet seismically qualified. [<2>].

The demineralised water tanks at Installation II (Units 2 and 3) – that play an important role in ensuring demineralised water stocks – are located in the direct vicinity of the service building. The walls of the building shall be seismically qualified and, if necessary, reinforced or provide appropriate protection of the tanks by other means. [<3>].

According to the current conservative analyses, soil liquefaction might occur in the acceleration ranges slightly exceeding the design basis, which may cause uneven settlement of the buildings (discussed in Section 2.2.1.1. of [3]). As a consequence, the underground lines and connections (pipelines, cables) at risk due to potential settlement of the main building shall be re-qualified and, if necessary, modified to allow for a relative displacement [<4>]. In addition, a state-of-the-art analysis shall be performed for the proper assessment of the existing margins of earthquake-initiated building settlement and soil liquefaction phenomenon [<5>].

### *1.1.3 Protected volume approach*

There are certain wall penetrations in the machine room of the essential service water pumps above the level Bf 95.12 m (Section 3.1.2. of [3]). The penetrations are not provided with water sealing, so flooding of the machine room may occur if a flood exceeding this level takes place. The water penetrating through the walls would accumulate in a sump and a permanently installed sump pump can remove it. Modification of the wall penetrations to a sealed design shall be carried out [<6>].

According to Section 2.1.2. of the report [3], automatic shutdown of the main condenser coolant pumps shall be provided when the condenser pipeline is damaged due to earthquake or other reason. It shall be ensured that the pipeline trenches are applicable to receive and drain the discharged water. If necessary, the dike shall be elevated or additional dam shall be constructed to avoid the flooding of the turbine hall or the cable tunnels [<7>].

### *1.1.4 Early warning notifications for extraordinary natural impacts*

Besides the fact that Paks NPP operates its own meteorological station, it is in daily touch with the Hungarian Meteorological Services. A similar relationship is maintained with the water authorities. Taking into account the relatively small size and geographical situation of Hungary, the current practice is satisfactory from every aspect and no task has been identified.

### *1.1.5 Seismic monitoring system*

The Paks NPP control rooms are equipped with seismic monitoring systems, which provide an alarm signal if a pre-defined acceleration level is exceeded. However, currently no such system exists which would initiate an automatic shutdown of the reactors for a given acceleration level ([3] 2.1.2). In the frame of the reconstruction project of the seismic instrumentation, which is in preparatory phase, the question of automatic shutdown shall be revisited [<9>].

### *1.1.6 On-site inspections, qualified walkdowns*

The licensee performed a large number of walkdowns during the TSR process, and deployed external experts when and where it was necessary. Records were taken about the walkdowns. The authority supervised the stress test assessments of the licensee in an inspection process. During the course of implementation of safety improvement measures, with special regard to those where the implementation of which was ordered by it, the authority shall apply regulatory inspections. If specific international standards, requirements become available for such inspections and qualified walkdowns, both the authority and the licensee shall adopt and apply them. Currently it was not justified to set up any additional task in this field.

### *1.1.7 Flooding margin assessments*

Section 3.2. of [3] determined that the site of Paks NPP is not prone to flooding, since the formation level of the embankment both on the opposite side of the Danube and upstream on the right bank is lower than the level of the site. Consequently, should an extreme high water level occur, the opposite bank and areas far from of the plant site will be flooded. No open task exists.

### *1.1.8 Assessment of external hazard margins*

Section 1.1.2. discussed task [<5>] in relation to earthquakes. Apart from that, the seismic resistance margins of buildings and equipment have been recently reviewed using the most advanced techniques and appropriate margins have been observed (see: [3] 2.2.). Section 4.2.2. of the report [3] describes that one of the statements of the latest Periodic Safety Review dated to 2008, that evaluation of loads caused by weather impacts is not in compliance with modern expectations. Accordingly, the assessment scheduled a new, supplementary analysis. The deadline for that is the end of 2012. Following the submittal of the results of those, the authority will review these assessments.

## *1.2 Tasks from the stress test peer review report of Hungary [5]*

The report [5] contains recommendations for the authority in relation to earthquakes, to closely supervise and inspect the implementation of those actions, which the licensee plans to implement to make certain structures (underground lines and connections) of the plant more resistive against the effects of a potential uneven building settlement occurring due to the effect of a possible soil liquefaction. Similarly, it recommends revision of the database containing the seismic classification of certain systems, structures and components. This revised database was completed by April 30, 2012 and its regulatory supervision was also performed. Also the ENSREG peer review [5] recommended the oversight of modification of the wall penetrations of the essential service water system to a sealed design and of the activities for necessary reinforcements against extreme weather conditions. It is true for all these activities that the authority oversees and reviews the process and results of the tasks accomplished by the licenses according to the normal regulatory procedures. The recommendations of document [5] therefore did not necessitate identification of additional tasks.

## *1.3 Tasks from the recommendations of the 2nd Extraordinary Review Meeting of the CNS*

In Topic 1 of the 2nd Extraordinary Review Meeting of the CNS held in August, 2012, which addressed external natural hazards, five thematic recommendations were formulated. It is expected from the member states of the Convention to report during the next, 2014 ordinary review meeting about:

1) Results of reassessments of external hazards with emphasis on changes to licensing basis.
2) Peer reviews of assessments and their results.
3) Additional improvements taken, or planned, based on the reassessments.

4) Activities taken, or planned, to improve safety culture based on lessons learned from the Fukushima accident.
5) Regulatory changes concerning external events that are already expected to be reported.

These five themes are discussed below:

### *1.3.1 Reassessments of external hazards*

This action was accomplished by Paks NPP during the last Periodic Safety Review completed in 2008. The results were reassessed in the frame of the EU Stress Test [3] and presented in Sections 1.1 and 1.2.

### *1.3.2 Peer review of reassessment*

The reassessment took place during the peer review phase of the EU Stress Test, the results of which were discussed in section 1.2.

### *1.3.3 Additional improvements taken or planned based on the reassessments.*

Details were discussed in Section 1.1.

### *1.3.4 Safety culture*

Within the topic of external natural hazards, during the course of the stress test, it was revealed corresponding to safety culture (Sections 2.1.2. and 2.2.4. of [3]) that seismic-proof fixing of temporary, non-process equipment in the outage periods and recovery of fixings dismantled for maintenance purposes are not duly regulated. Paks NPP defined a corrective action in relation to that: "Extraordinary attention shall be paid to seismic-safety related housekeeping and full recovery of fixings after main outages. Fixing of the non-process equipment and maintenance tools that could adversely impact process equipment during outages shall be provided." [<8>]. The authority inspects the implementation of the action during post-outage start-up process of the reactors.

### *1.3.5 Review of regulatory requirements*

The full revision of the regulatory requirements started in 2009 and terminated at the beginning of 2012. A further revision has been taking place with the involvement of external experts. The result of this revision will be the identification of the necessary amendments of the system of requirements [<50>]. Additional amendments of the requirements will be planned and scheduled when such modified international standards are issued (e.g. NAÜ, WENRA, NEA), which go beyond the current domestic norms (see also Part II Section 5!).

## *1.4 Tasks additional to the above expectations*

Primary circuit damage for the effect of design basis earthquakes was excluded by the seismic-reinforcement projects implemented earlier. However, due to implications from the Fukushima Daiichi accident, such improbable, complex cases shall also be taken into account as extension of the design bases (See: Section 2.1.2. of [3]). Accordingly, the existing symptom-based emergency operating procedures shall be reassessed as to whether they support an optimal recovery in such a combined situation [<10>].

Section 2.2.1.2 of [3] concludes that the 400 kV and 120 kV substations are not safety systems and therefore they are not seismically reinforced. These substations however, might provide many alternative electric supply opportunities, if they are not damaged. The earthquake protection of the substations and the gears for automatic switching the plant to isolated operation shall be re-evaluated and reinforced if necessary [<11>].

According to Section 5.2.2. of [3] maintenance and inspection procedures to be applied in the situation of the extreme low level of Danube were not satisfactory. Therefore, the periodic inspection, maintenance and operational testing regarding the equipment to be applied in case of low water level shall be supplemented. The inspection, testing and maintenance instructions, which are still missing, shall be developed [<12>].

During the stress test the authority required [10] that a "list of such system components important to safety, which are endangered by electromagnetic effects (including the effects induced by lightning) and thereby need to be classified accordingly, shall be compiled to display whether or not a given component is adequately qualified" [<13>]. Based on the list the authority and the licensee can specify reinforcements and corrective actions.

Also the authority resolution terminating the stress test assessments [10] ordered that "it shall be analyzed if the lack of seismic qualification of the machine racks and travelling water band screens of the essential service water system jeopardizes the ultimate heat sink function and, if necessary, the adequate exclusion measures shall be implemented" [<14>].

# Topic 2: Loss of safety systems

## *2.1 Tasks derived based on the ENSREG "Compilation of Recommendations and Suggestions" document [9]*

### *2.1.1 Application of means providing alternate cooling and heat sink*

Corrective actions planned in Section 5.2.5. of report [3]: the operator shall maximize the available inventory of the stored demineralised water in all operation states [<15>]. The access to the connection point of the auxiliary emergency feedwater system in accident conditions shall be improved. Connection points shall be established on the demineralised water tanks to allow the water supply, through the auxiliary emergency feedwater system, by mobile equipment. Arrangements shall be laid down in instructions for additional external supply opportunities from the Danube and the fishing lakes. [<16>]. The potential setting of the boron concentration of water inventories from external sources, and its storage, shall be solved and supply mode of borated water inventories to the containment shall be regulated in an operating instruction [<17>]. By provision of an appropriate electrical power supply it shall be established that the bank filtered well plant, which can be used irrespective of the water level of the river, be able to supply water to the essential service water system via the existing connections in accident situations [<18>]. The accessibility of the water reserve available in the closed segment of the discharge water canal for the earthquake resistant fire water pump station of Installation II that is equipped with an individual diesel power supply shall be solved [<19>]. Similar to the connection existing on Installation I, the water supply shall also be solved for Installation II from the fire water system to the essential service water system through the technology cooling water system [<20>]. The equipment necessary for the cooling water supply to at least one diesel generator of each unit from the fire water system shall be provided and the operating instruction shall be completed with the measures to be implemented [<21>]. Topic 3 deals with the equipment to be deployed from external organizations that should be applied in case of severe accidents. See actions [<32>, <33>].

### *2.1.2 Enhancement opportunities of on-site and off-site AC power supply*

The following corrective actions were decided based upon Sections 5.1.1.3., 5.1.5., 5.2.5. and 5.3.1. of report [3]: utilizing the fuel storage capacity of the tanks of the safety diesel generators, the amount of stored diesel fuel shall be increased, and this shall be incorporated in the procedures [<22>]. Protection of the 400 kV and 120 kV substations, which are not of safety category and therefore are not seismically reinforced and the automatic switching of the plant to isolated operation against earthquakes shall be evaluated and reinforced if necessary [<11>]. Power supply from the safety trains of - filters of the essential service water system shall be established [<23>]. Appropriately protected independent severe accident diesel generator(s) shall be installed after assessment of the necessary capacity and determination of the design requirements including beyond design basis hazards [<24>]. Out of the two power plants being able to supply external electric power via dedicated lines, the black-start capability (start-up from own diesel generator) shall be established for the Litér gas turbine plant [<25>]. Actions discussed in the previous section can also be mentioned here: actions [<18>] and [<21>]. Procedures shall be developed for the use of the possible, but currently not applied, cross-links of the safety power trains across the units. The procedures shall cover the normal operational trains, as well as the backup and safety buses. [<26>]. Possible cross-links shall be studied and the concluding modifications shall be carried out for providing safety electrical power supply from any operable emergency diesel generator in any unit to the safety consumers of any other unit [<27>]. Topic 3 addresses the provision of electric power supply equipment of external organizations to be applied in severe accidents in the plant, see action [<33>].

### *2.1.3 Enhancement opportunities of DC power supply*

Paks NPP assessed the battery stations during the stress test. The conclusion was that if the reliability and amount of AC power supply is available then there cannot be a problem with the DC power supply, since the battery stations can be charged from any of the AC power supplies. After considering the corrective actions related to AC power supply described above, no additional corrective actions were identified for DC power supply, see sections 5.1.1.2. and 5.1.2.1. of report [3].

### *2.1.4 Operational and preparatory actions*

Actions [<8>], [<10>] and [<6>] in Topic 1, and actions [<22>, <15>, <16>, <17>,<21> and <26>] described above, along with actions [<33>, <34>, <35>, <37>, <38>, <42>, <43>, <41>] described below in this topic and in Topic 3, address the development and enhancement of operational and other application procedures. Action [<12>] of Topic 1 should also be mentioned here, which foresees the practical training of the personnel.

### *2.1.5 Instrumentation and monitoring*

Although the task according to corrective action [<9>] of Topic 1 itself is not related to instrumentation, but builds on the results of seismic instrumentation reconstruction decided prior to the stress test. Beyond that, action [<36>] of Topic 3 address the instrumentation of the Protected Command Centre, while action [<46>] required by the authority schedules the revision of the adequacy of the emergency related on-site and off-site radiation monitoring devices for earthquakes and loss of power supply.

### *2.1.6 Shutdown improvements*

Corrective actions are only indirectly assigned to shutdown state, in relation to two analyses actions. Section 2.1.17. will describe them. Based on section 2.2.1., 5.2.4. and 5.2.5. of the stress test report [3] action [<28>] will clarify the necessity of a time limit for the state of shutdown but not for a cold reactor, while action [<41>] connected to Topic 3 includes 3-dimensional hydrogen distribution calculations for the simultaneous accident state of one open reactor in refuelling state, one operating reactor and two spent fuel pools (considering that two units have a common atmosphere reactor hall).

### *2.1.7 Reactor coolant pumps seals*

Seals of the main coolant pumps of Paks NPP do not degrade during shutdown; therefore the issue in Hungary is not relevant, which has been satisfactorily clarified during the course of the peer review (last Para. of Section 3.2.2.2 of [5]).

### *2.1.8 Improvement of ventilation capacity in total loss of power supply*

Section 2.1.2. of [3] dealt with the provision of AC power supply. If this is available, then ventilation connected to safety supply, required for the operation of the process equipment and compartments for personnel to stay is ensured. No separate action was necessary except for the Protected Command Centre. Action (PCC) [<48>] of Topic 3 plans the re-assessment of air conditioning for the PCC and installation of operable equipment that can be operated from an adequate power diesel generator.

### *2.1.9 Improvement of main and backup control rooms for long term habitability after a total loss of power*

Taking into account Section 4.2.1. of [3], after the improvement of safety supply according to Section 2.1.2. the habitability of the unit control room will be appropriate (also taking into account the DC power supply according to Section 2.1.3). The situation is different in the case of the command centres designed for managing emergency response: both the Protected Command Centre and the Backup Command Centre corrective actions had to be decided ([<48>] and [<49>]). These are described in Topic 3.

### *2.1.10 Improvement of robustness of spent fuel pools for various events*

Further actions, going beyond the contents of Section 1.2.2. and 2.1.2. of the Stress Test report [3] have also been identified: [<32>, <34>, <35>]; they appear in the field of emergency preparedness (see Topic 3).

### *2.1.11 Improvement of separation and independence of safety systems*

One improvement action was decided in relation to separation (see: Section 2.1.2. and 2.2.4. of [3]). The intention is to timely shut down the large diameter and large flow-rate condenser cooling water systems, if damaged, and to allow for the whole water volume discharged [<7>]. In another respect, the stress test actions are rather meant to increase diversity than to improve separation and independence.

### *2.1.12 Flow path and access availability*

Instead of maintenance of routes with special tools, actions rather meant to ensure parallel, diverse water and electric power supply routes were decided. Actions [<11>, <16>, <20>, <21>, <25>, <26>, <27>] were already mentioned in Sections 2.1.1. and 2.1.2., and actions [<32>, <33>, <42> ] described in Topic 3. The latter is related to routes of liquid releases during severe accidents. Action [<16>] relates to ensuring accessibility and the tasks [<43>, <44>, <45>] also for accident conditions.

### *2.1.13 Provision of mobile devices and their adequate storage*

Actions [<8>] and [<12>] described in Topic 1 and tasks [<34>] and [<18>] in Topic 3 are connected to mobile devices and appropriate storage.

### *2.1.14 Bunkered/hardened systems*

Action [<24>], which also belongs to Topic 3, was concluded based on the considerations in Section 5.1.3 of the national regulatory stress test [3]. The placement of these diesels is regarded as hardened. Action [<32>] aimed at establishing a new, hardened coolant supply route to the spent fuel pool was discussed in Section 5.2.3. of the same report. The Protected Command Centre and the Backup Command Centre shall be reinforced according to actions [<47>] and [<48>]. These actions also belong to Topic 3. Action [<2>] discussed in Topic 1 on the hardened placement of fire brigade and personal protective equipment.

### *2.1.15 Improvement of response capability to multiple accidents on the site*

The following actions of Topic 3 address the potential multiple accidents of the units on the site: [<24>, <36>, <37>, <41>].

### *2.1.16 Equipment inspection and training programmes*

The necessity for a more elaborated formal control of NPP staff activity by procedures in relation to supplementary actions to be taken when an extreme low level of the Danube occurs was determined based on Section 5.2. of [3] that also included a more frequent training and exercise of the staff for these activities [<12>]. This belongs to the issues discussed in Topic 1.

### *2.1.17 Further studies to address uncertainties*

Performance of further assessments was decided in concert with Sections 2.1.2., 2.2.1., 2.2.4., 6. and 7.3. of report [3]. Additional actions [<5>, <9>, <10>, <11> and <14>] discussed in Topic 1 can also be mentioned here. Action [<28>] which foresees a probabilistic assessment for closed reactor states under 150 °C primary circuit temperature can also appear in this part. Some actions of Topic 3 are also relevant to this issue: [<30>, <38>, <41>, <46>].

## *2.2 Tasks from the stress test peer review report of Hungary [5]*

The report of the peer review team contains one recommendation in relation to this topic: *"The possibilities of interconnection of existing equipment are beneficial. However might also lead to loss of separation. Such improvements or modifications should be prepared carefully. Before the implementation, separation issues should be investigated.* (See Section 3.3 of [5]). No corrective action is required in relation to this recommendation. If the interconnections are established as part of emergency/accident management, when it is necessary anyway to consider the pros and cons of the action in the given situation, then obviously no corrective action can be formulated as a preparatory action. Notwithstanding that the interconnections are established under normal circumstances as part of preparation for the accident situations, then these are modifications of the systems. The nuclear safety regulations specify the modification process and the requirements for the respective supporting analysis and the modification is subject to authority approval. This is a satisfactory provision to comply with the above recommendation.

## *2.3 Tasks from the recommendations of the 2nd Extraordinary Review Meeting of the CNS*

Connecting topic: 2 – Design Issues

Recommendations based on the final summary report of the 2nd Extraordinary Review Meeting of the CNS [7] and the corresponding thematic rapporteur reports, which are not published, are listed below. Also the reasons are specified why no additional improvement actions are decided.

### *2.3.1 Increasing plant robustness to face unexpected challenges*

The expectation, according to the detailed explanation, is the safety improvement of existing nuclear power plants and the improvement to designs of new reactors by taking account of natural hazards more severe than the ones considered in the design basis.

During the stress test [3] the beyond design basis effects were examined for Paks NPP and the necessary improvement actions were determined (see Topic 3). Additionally, the relevant regulation for new reactors, in harmony with international recommendations, contains the requirements for the extension of design basis and severe accidents.

### *2.3.2 Safety objective for new NPPs*

The safety objective for new nuclear power plants is defined through the introduction of the approach of "design extension conditions": long term off-site radioactive contamination due to severe accident shall be prevented.

The recent update of the Hungarian Nuclear Safety Codes contains this requirement.

### *2.3.3 Safety requirements for equipment used in design extension conditions*

Requirements for the equipment designed to apply in design basis extension state are included in the nuclear safety regulations both regarding fixed (installed) and mobile equipment and their storage location, in full compliance with the current international practices.

It should be noted in relation to each of the above themes that the HAEA follows, and the Hungarian regulations incorporate regularly the enhancements of the international safety standards and recommendations.

# Topic 3: On-site emergency response, accident management and recovery

## *3.1 Tasks derived based on the ENSREG "Compilation of Recommendations and Suggestions" document [9]*

The ENSREG document [9] details the expectations regarding on-site emergency preparedness and severe accident management, so the tasks in this issue are only described according to this document and recommendations of the CNS Extraordinary Review Meeting. Recommendations of the Stress Test Peer Review to Hungary [5] are referred to within the issues described.

### *3.1.1 Compliance with WENRA reference levels*

#### *3.1.1.1 Hydrogen mitigation in the containment*

This issue is in relation to Theme 2.2. of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS

Paks NPP had decided to introduce the Severe Accident Management Guidelines before the accident of Fukushima-Daiichi NPP as one of the conclusions of the earlier Periodic Safety Reviews, as well as the implementation of the respective technical modifications. One of the technical modifications was the installation of hydrogen recombiners in the containments designed to cope with severe accidents, which was accelerated as a response action to the accident in Japan and carried out before the end of 2011 for each of the units.

Section 6.3.2. of the Hungarian Stress Test report [3] and Section 4.2.1.3. of report [5] address this issue. No further action is necessary.

#### *3.1.1.2 Hydrogen monitoring system*

This issue is in relation to Theme 2.2. of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

Installation of the severe accident instrumentation has been taking place for Paks NPP unit also in the frame of the above describe technical modifications that had been decided before the accident of Fukushima Daiichi NPP. This involves the construction of the hydrogen monitoring system, which may be powered from the severe accident diesel generators. The modification has already taken place in unit 1 and unit 2, while it will be implemented in 2013 in unit 3 and in 2014 in unit 4 [<29>].

Section 6.3.7. of the Hungarian TSR report [3] and the Section 4.2.1.3. of report [5] address this issue. No further action is necessary.

#### *3.1.1.3 Reliable depressurization of the reactor coolant system*

This issue is in relation to Theme 2.2. of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

Installation of the severe accident diesel generators have also taken place for Paks NPP in the frame of the above described technical modifications decided before the accident of Fukushima Daiichi NPP. This modification is accomplished for all 4 units of the plant. As a means of primary circuit depressurization, the system of overpressure protection valves connected to the pressurizer vessel was modified to ensure its power supply from the severe accident diesel generator, which means a significant safety gain from the aspect of implementation of depressurization.

Section 6.1.2.1. of report [3] described the modification, report [5] did not specifically address this issue. No further action is necessary.

#### *3.1.1.4 Containment overpressure protection*

This issue is in relation to Theme 1.4. and 2.2. of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

Section 6.3.3. of report [3] described the technical solutions available in Paks NPP in order to prevent over-pressurization of the containment. The report decided the following action for the severe accident pressure conditions to prevent unfiltered release [<30>]:
An analysis of the long-term (beyond 1 week) progression of severe accidents shall be carried out. Based on the analysis results, a system that is able to prevent the long-term, slow over-pressurisation of the containment shall be developed and implemented.
Section 4.2.2.2. of section [5] confirmed the necessity of such an action. Paks NPP prepared the concept for the implementation, which recommends the installation of an active cooling system.

#### *3.1.1.5 Molten corium stabilization*

This issue is in relation to Theme 2.2. of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

Among the severe accident management measures decided by Paks NPP before the accident of Fukushima-Daiichi NPP the licensee of Paks NPP selected the strategy of in-vessel maintenance of the molten core. According to that, the molten core can be stabilized within the reactor pressure vessel by flooding the reactor cavity and external cooling of the vessel. The respective modification has already been implemented for unit 1 and unit 2, while it will take place in 2013 and 2014 during the refuelling outages of unit 3 and unit 4 respectively.
Section 6.3.5. of report [3] described the modification and Section 4.2.1.3. of report [5] addressed the issue [<31>]. No further action is necessary.

### *3.1.2 Severe accident management hardware provisions*

This issue is in relation to Theme 2.1. and 5.5. of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

The design basis for severe accident management modifications decided before the accident of Fukushima Daiichi NPP had been the provision of operability under the specified severe accident circumstances. In addition to that the following actions have been decided:
According to Section 5.1.5. of report [3] in addition to the existing severe accident diesel generators supplying electrical power to measurement and control systems described in accident management procedures, it is justified to install a diverse accident diesel generator, which can supply electrical power to safety consumers having roles in severe accident prevention and long term accident management. The capacity of the diverse accident support diesel generator shall be determined in such a way that it shall be capable of supplying electrical power to the required consumers, pumps and valves. The number and capacity of the independent accident diesel generators shall be determined with the consideration of the

safety principles. Simultaneous loss of power of more, even all, units shall be assumed and the cooling needs of the reactors and the spent fuel pools shall be considered. The independent severe accident diesel generators shall have appropriate protection against beyond design basis external hazards (earthquake, natural hazards, flooding) of the installed emergency diesel generators and they shall be totally independent of other systems (such as the cooling or electric supply systems) of the plant. The design basis for the independent severe accident diesel generators shall be determined in such a way that the accident diesel generators would be available even if the design basis loads of the installed safety diesel generators were exceeded. The concept document prepared for the action contains the installation of 1-1 diesel generator both for Installation I and II, the capacity of which is enough to supply one safety train [<24>].

According to Section 5.2.5. of report [3] the nuclear power plant has 9 wells, each having a large diameter and a depth of 30 m that are bored in the pebble bed of the Danube; these wells are permanent water sources providing an unlimited quantity of water independently of the water level of the Danube. A connection system is installed from the well plant to the essential service water system. Electric power supply shall be provided from a duly protected fixed or mobile diesel generator to supply, in emergency, the submersible pumps of the wells drilled into the pebble bed of the Danube bank [<18>].

According to Section 5.2.5. of report [3] a new water supply route connected in the courtyard by flexible means shall be constructed that is protected from external hazards (such as earthquake). The spent fuel pool shall be filled from the borated water reserve specified above via this line. The required operations shall be specified in procedures [<32>].

According to Section 6.1.5. of report [3] corresponding to management of severe accidents, for the construction of an external water supply route to the auxiliary emergency feedwater system, the equipment necessary for the connection of external origin mobile diesel generators and pumps to the systems shall be purchased [<33>].

### *3.1.3 Review of Severe Accident Management Provisions Following Severe External Events*

This issue is in relation to Theme 1.2. and 5. of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

Development of severe accident management guidelines was one of the severe accident management actions decided by Paks NPP before the accident of Fukushima Daiichi NPP. One of the design aspects of the guidelines was the provision for their implementation under the assumed severe accident circumstances. The guidelines enter into force in the various units, when the respective technical modifications are completed: until the end of 2012 regarding unit 1 and unit 2, while in 2013 and 2014 in unit 3 and unit 4, respectively. In the course of the stress test the following action has been decided to supplement the guidelines:
A severe accident situation simultaneously taking place in the reactor and the spent fuel pool shall be managed by the development of a severe accident management guideline. Technical modifications, generated by the implementation of other actions, shall be implemented in the concerned Severe Accident Management Guidelines (SAMG), and the method of the use of external supply opportunity shall be described in procedures [<34>, <35>].

Section 6.1.1.2. of report [3] described the SAMGs and Section 4.1.5. of report [5] confirmed that they conform to the international expectations and it did not identify any need for additional actions.

### *3.1.4 Enhancement of Severe Accident Management Guidelines*

This issue is in relation to Theme 1.2. and 4. of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

In addition to that which has been described in Section 3.3.3., Section 6.3.8. of report [3] dealt with further improvement of severe accident guidelines for multi unit accidents. According to the conclusion the guidelines themselves can be applied independently for each unit respectively, but the resources are not sufficient to carry out the guidelines in parallel. So the following action has been determined:
The physical arrangement and instrumentation of the Technical Support Centre, established at the Protected Command Centre, shall be extended to provide sufficient resources for simultaneous management of severe accidents occurring on more than one (even all 4) units [<36>]. The structure of the organization responding to accidents affecting multiple units and the number of staff shall be determined; procedures shall be developed for personnel and equipment provisions, as well as for shift changes [<37>].

The issue was discussed in Section 4.2.1. of report [5], while its Section 4.3. confirmed the decided action.

A further action that increases the tools of the guidelines are that Paks NPP is to initiate the provision of black-start capability (start-up from its own diesel generator) for the Litér gas turbine, such action has also been discussed in Section 2.1.2 [<25>]. The action was grounded in Section 5.1.1.2. of report [3] and discussed by Section 3.2.2.1. of report [5].

### *3.1.5 Validation of enhanced severe accident management guidelines*

The issue corresponds to Theme 1.2 of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

In the course of regulatory licensing of severe accident management guidelines, the authority obliged the operator to verify the guidelines in the frame of an emergency response exercise. This has taken place with a regulatory inspection. As the result of the verification the guidelines have been introduced for unit 1. A similar verification would take place after any supplementation or enhancement of the guidelines. Report [3] did not discuss this verification, but in the course of country peer review the international peers received information on the content of that. Report [5] did not foresee any action in this field.

### *3.1.6 Severe accident exercises*

The area of emergency response exercises has been shortly discussed in Section 6.1.1.5. of report [3]. According to the Hungarian legislation the emergency response organization of the NPP is required to carry out a full-scale nuclear emergency exercise every year that involves the whole personnel of the organization. Off-site emergency response organizations shall be invited to take part in the exercise. The scenario of the exercise shall make it possible to practice the implementation of on-site organizational and technical measures in severe accident situations. No action was determined in this area.

### *3.1.7 Training of severe accident management*

This issue is in relation to Theme 1.2. and 4. of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

By the introduction and implementation of severe accident management guidelines and modifications the operator also introduced the training of severe accident situations (see 3.3.5.) and proposed its connection with emergency response exercises. Consequently the emergency response exercises provide an opportunity to practice the tools and procedures of severe accident management. In order to prepare for multi unit accidents the action described in Section 3.3.4. was determined. The training and exercise of multi unit emergencies can take place after the implementation of that action.

A software-based severe accident training simulator shall be developed [<38>]. In the first stage of the two-stage development the current simulator will be extended for the education of the staff of Technical Support Centre, while later it will be applicable to train a wider scope of the potential users.

Section 6.1.6. of report [3] and Section 4.2.4.2. of report [5] discussed the issue related to severe accident management. No further action is necessary.

### *3.1.8 Extension of severe accident management guidelines to all plant states*

This issue is in relation to Theme 1.2. of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

In the frame of severe accident management guidelines elaborated in the frame of severe accident management measures decided before the accident of Fukushima-Daiichi, NPP cover the low power and shutdown mode of the reactor, as well as the severe accident situation of the spent fuel pool. Section 6.2. of report [3] and Section 4.2.1.2. of report [5] discussed the guidelines. No further action is necessary in this area.

### *3.1.9 Improvement of communication*

This issue is in relation to Theme 2.2. of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

Section 6.1.2.4. of report [3] discussed emergency communication and the improvement action below has been determined based on the considerations:

The methods to guarantee the conditions for radio communication shall be assessed in the case of permanent loss of electric power and earthquakes and the necessary actions shall be performed [<39>].

Informatics mirror storage computers shall be installed, both at the Protected Command Centre and the Backup Command Centre, containing the necessary scope of data (i.e. technical documentation, personal data, etc.) [<40>].

Section 4.2.2.2. of report [5] confirmed the actions.

### *3.1.10 Presence of hydrogen in unexpected places*

This issue is in relation to Theme 5. of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

During the stress test (Section 6.3.8. of [3]) it was determined by conservative, lumped-parameter codes what amount of hydrogen is generated in the accident of two spent fuel pools, one reactor in shutdown and the other reactor in operation and what hydrogen concentration occurs in the reactor hall. According to the calculation results inflammable concentrations may occur, which can lead to turbulent burning. An action was therefore decided in order to determine the distributions using less conservative, three-dimensional analyses beyond the use of the lumped-parameter models [<41>].

The action was confirmed in Section 4.3. of report [5]. Need for further action will be the result of the analysis.

### *3.1.11 Large volumes of contaminated water*

This issue is in relation to Theme 1.4. of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

Section 6.1.3.3. of report [3] determined that the plant is not fully prepared to manage liquid radioactive wastes generated in large quantities during a severe accident. The following action was therefore decided:
Procedures shall be developed for the management of liquid radioactive wastes during severe accidents. The risk, potential routes and possible monitoring tools and methods of liquid form release of radioactive materials shall be examined and the measures necessary, and possible to respond to in such a situation, shall be specified [<42>].

### *3.1.12 Radiation protection*

This issue is in relation to Theme 1.4. and 6 of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

Report [3] determined (6.1.3.5.) that the following actions are necessary in order to improve the access in severe accident conditions impaired by the adverse radiation conditions:

Procedures for collecting and transporting emergency response personnel shall be developed and the necessary means and rules of their provision shall be determined [<43>]. A shielded transport vehicle deployable at significant radiation levels shall be procured [<44>]. The rules for exemptions from the air ban around the plant shall be modified to manage airborne support [<45>].

According to authority resolution [10] the applicability of fixed radiation monitoring devices installed on, and in the vicinity of the site to support emergency response activities after an earthquake and total loss of power shall be assessed [<46>].

The actions were addressed in Section 4.2.1.5. of [5].

### *3.1.13 On-site emergency centre*

This issue is in relation to Theme 3 of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

The NPP has an appropriate on-site emergency centre, the so called Protected Command Centre and shelters suitable for the stay of response personnel. In order to further improve the situation the following actions have been decided:

Seismic qualification of the on-site shelters not yet qualified shall be performed and non-earthquake resistant equipment in the shelters shall be improved. A nuclear emergency response centre resistant to earthquakes of peak ground acceleration higher than design basis earthquake shall be established [<47>].

Air-conditioning of the Protected Command Centre shall be re-assessed and an appropriate piece of power equipment shall be installed that can also be supplied by diesel generator [<48>].

A Backup Command Centre that complies with protection requirements and is equivalent with the Protected Command Centre in terms of management and communication shall be established [<49>].

The actions were discussed in Section 4.2.1.5. and 4.3. of report [5].

#### *3.1.14 Support to local operators*

According to Section 6.1.4 (and 6.1.3.1. and 6.1.3.9.) of report [3] the plant is duly prepared for getting support from external forces in severe accident situation. No further action is necessary. The area was discussed in Section 4.2.1.1. of report [5].

#### *3.1.15 Level 2 Probabilistic Safety Assessments (PSA)*

This issue is in relation to Theme 1.3. of Topic 3 of the 2nd Extraordinary Review Meeting of the CNS.

Paks NPP has Level 1 and Level 2 PSA assessment for each operating mode of the reactors and the spent fuel pools. Since the Severe Accident Management Guidelines are not event based, but symptom based, low probability event sequences are not excluded from the scope based on PSA results. No action is necessary.

The area is addressed in Section 3.1.3. of report [5].

#### *3.1.16 Severe accident analyses*

No additional actions have been determined for further enhancement of severe accident analyses of Paks NPP beyond those that have been described above.

## *3.2 CNS themes not, or not fully, addressed above*

**Theme 1.1: review of regulatory framework**

Requirements for beyond design basis accidents and severe accidents appear in the regulatory requirements after being revised in 2011 and 2012. A new revision of the regulations is planned after the revision of IAEA safety standards and WENRA reference levels are completed and published. See Topic 4 in Part II!

**Theme 1.4: others (including alternative water sources, recovery from SA, radiological analysis)**

Section 2.1.1. discusses the alternative and new diverse coolant supply possibilities. Section 1.1.8. addressed the robustness of essential systems against extreme conditions. Certain aspects of long term severe accident management were covered in Sections 3.1.1.4. and 3.1.4.

**Theme 4: multi-unit aspects**

Section 2.1.2. discusses sharing of systems and establishment of cross-links between units.

**Theme 5: spent fuel pool aspects**
Actions for further enhancement of spent fuel pool cooling are included in Sections 2.1.14. and 3.1.2.

**Theme 6**
Decision-making process of the emergency response organization and its relation to severe accident management are described in Section 6.1.1.2. of report [3].

# Part II: Additional topics from the 2nd Extraordinary Review Meeting of the CNS

## Topic 4: National organizations

### *4.1 Review of nuclear safety and/or radiation protection laws, requirements and recommendations*

This issue is in relation to Theme 1 of Topic 4 of the 2nd Extraordinary Review Meeting of the CNS.

As quoted from Act CXVI of 1996 on atomic energy (hereinafter referred to as Atomic Act), Article 8 (4) states that:

"*The organization supervising the use of atomic energy shall*

...

*b) in the field of application of atomic energy*

*ba) follow the general directions of international development, especially the international development of regulations, and make proposals on the necessary national measures and the establishment of laws;*

*bb) follow the technical development results, international experience and expectations; and*

*bc) follow the compliance with the laws under its competence; initiate actions based on its conclusions, make proposals on the necessary amendment to laws or establishment of new laws;*"

In accordance with Article 3 (7) of Govt. decree 118/2011 on the nuclear safety requirements for nuclear facilities and the related regulatory activities:

"*The Nuclear Safety Code, with the consideration of scientific results, national and international experience, shall be reviewed and if necessary updated at least every five years. The guidelines shall be reviewed periodically based on the decision of the nuclear safety authority or upon the request of the licensees.*"

As an outcome of the latest revision of the Hungarian nuclear safety regulations, the Govt. decree 118/2011. (VII. 11.) Korm. and its annexes (the so called Nuclear Safety Codes) were issued, which establish the national nuclear safety requirements. The fundamental objective of the revision was to utilize the new international expectations and the national experiences gained in the meantime. Govt. decree 37/2012. (III. 9.) Korm. supplemented and amended these regulations in order to establish requirements for a new nuclear power plant unit to be constructed in Hungary. As an outcome of the revision the new regulations include the WENRA (Western European Regulatory Association) Reference Levels (i.e., the expected safety levels generally approved by the European authorities) and the latest safety standards of the International Atomic Energy Agency. The revision, because of its schedule, did not aim at utilizing the experience gained from the Fukushima accident. The lessons to be learned regarding regulations can only be identified after the comprehensive assessment of the accident; the preliminary results have not required any immediate amendment to the legislation.

Hungary undertakes the utilization of the lessons learned from the Fukushima Daiichi accident during the next revision of the nuclear safety legislation. The review should be conducted taking into consideration the following:

- information available regarding emergency response,

- international experience and identified corrective actions,
- statements of the CNS review conference and the stress test on external threats, low probability events, performance of safety functions, emergency response, requirements for severe accident management and on the effective design basis.

The rules of regulatory activities, the independence of the authority, as well as the availability of the resources, needed for the supervisory activity should be reviewed.

Another important source of amending the legislations is the supplementation of the WENRA reference levels, which is expected to be completed by the end of 2013. Additionally, amendments to the nuclear safety legislation could be required after the review of the IAEA recommendations and the European nuclear safety directive; however they will be realized in a longer term.

## *4.2 Changes in the functions and responsibilities of the authority*

This issue is in relation to Theme 2 of Topic 4 of the 2nd Extraordinary Review Meeting of the CNS.

The role, competence and tasks of the HAEA were presented in the CNS report. The analyses of the Fukushima accident have not yet revealed such a deficiency which requires any change in the functioning of the HAEA. At the request of the Hungarian Government, the IAEA IRRS mission will evaluate the performance of the authority in 2015. If the IRRS mission or the review discussed in Section 4.1 reveals any deficiency in the Hungarian regulatory system, then Hungary is committed to make the necessary modifications.

## *4.3 Review and improvements to aspects of emergency preparedness and response*

This issue is in relation to Theme 3 of Topic 4 of the 2nd Extraordinary Review Meeting of the CNS.

The training and exercise programmes for the central, sectorial, regional and local organizations of the Hungarian Nuclear Emergency Response System, as well as for the on-site emergency response organizations are discussed in detail in Section 5.7.

The integration of external forces to fire fighting and technical rescue is discussed in Section 5.4.

The emergency planning zones were established based on the relevant IAEA recommendations; the re-sizing of the emergency planning zones is not a need based on the lessons learned from the Fukushima Daiichi accident.

In line with the international convention on early notification, Hungary maintains bilateral cooperation agreements with each neighbouring country. According to these bilateral agreements, Hungarian experts visit the emergency exercises of the neighbouring countries as observers, as well as Hungary invites the experts of these countries to participate in major Hungarian exercises as observers.

No action is needed based on the experience gained from the Fukushima Daiichi accident.

Nevertheless, the Fukushima Daiichi accident revealed certain areas, where the level of preparation should be verified in the frame of an emergency exercise. The main objectives of the national exercise planned to be held in the first half of 2013 are to practice communication with the media and to practice the implementation of certain protective actions with the involvement of invited members of the public. [<51>].

## *4.4 Openness, transparency and communication improvements*

This issue is in relation to Theme 4 of Topic 4 of the 2nd Extraordinary Review Meeting of the CNS.

In accordance with Article 8 (4) d) of the Atomic Act

*"The organization supervising the use of atomic energy ... shall inform the public on the safety of the use of atomic energy, nuclear security, its own activities, its major decisions and their substantiation, as well as on the applied safety, security and safeguards requirements via publishing the relevant information on its website;"*

The HAEA, on its website, continuously informed the public on the situation evolved in Japan and its consequences. The authority made available all relevant information on the preparation for, and execution of, the TSR as well as on the extraordinary review made by the IAEA.

The public information on the implementation of TSR actions does not require daily information provision; however, information could be provided regarding certain major events (e.g. when the implementation of the TSR action plan was ordered or during the annual press conferences). The interested parties can continuously follow the events on the website of the HAEA, since the major news is released thereon by the authority. Additionally, a "Bulletin" is published every six months, which includes information that may satisfy professional needs as well; Bulletins are sent in printed format to wider scope of people and organizations. The HAEA newsletters should also be mentioned as a communication channel, through which the authority provides information on the major events every three months; its part targeted at the general public is available at the HAEA website. The HAEA, according to law, annually reports its activity to the Hungarian Parliament. This report is discussed within the professional committees of the Parliament, who finally endorse it.

The outcomes of the analyses of the Fukushima Daiichi accident have not revealed such deficiency, which requires any change in the area of openness, transparency and communication.

## *4.5 Post Fukushima safety re-assessments and action plans*

This issue is in relation to Theme 5 of Topic 4 of the 2nd Extraordinary Review Meeting of the CNS.

Based on the expert review, the action plan prepared by the licensee and on the regulatory review (see Introduction), the HAEA ordered the scheduled execution of the required safety improvement measures. The authority continuously monitors, inspects and evaluates the progress in the implementation of the planned actions.

## *4.6 Human and organizational factors*

This issue is in relation to Theme 6 of Topic 4 of the 2nd Extraordinary Review Meeting of the CNS.

The outcomes of the analyses of the Fukushima Daiichi accident have not revealed any such deficiency, which requires any change in this area. If the international reviews, or the review presented in Section 4.1, reveal the need for changes in the field of human and organizational factors, then Hungary is committed to implement the necessary changes.

## Topic 5: Off-site emergency response[2]

This issue is in relation to Topic 5 of the 2nd Extraordinary Review Meeting of the CNS.

### *5.1 Legal background*

The organizational structure of the national disaster management system, the tasks of ministers and governmental bodies concerned in disaster management regarding prevention, preparation and response, and the tasks of the disaster management organization are regulated by Act CXXVIII of 2011 on disaster management and the amendment of certain relating acts, as well as by the implementing Govt. decree 234/2011. (XI. 10.).

The organizational structure and tasks of the Hungarian Nuclear Emergency Response System (HNERS) are regulated by Govt. decree 167/2010. (V. 11.) Korm. The Disaster Management Coordination Inter-ministerial Committee, and its organizational and operational rules are established by Govt. resolution 1150/2012. (V. 15.) Korm.

The comprehensive review of, and amendment to, the legal background completed in the last two years provided the basis for the establishment of a modern and effective national disaster management system. In harmony with the renewal of disaster management and with the consideration of the practical experience gained during the last decade, an implementing decree regulates the tasks of the organizations participating in the response as along with the general rules of international disaster management support and assistance request.

### *5.2 Hungarian Nuclear Emergency Response System (HNERS)*

The preparation for the response to radiological or nuclear events occurring during the peaceful application of atomic energy, as well as the mitigation and elimination of the consequences, are the tasks of the HNERS. The HNERS consists of those central, sectorial, regional and local organizations, which are concerned in the prevention of events entailing non-planned exposure to the public, as well as the mitigation and elimination of the consequences of such events.

The Disaster Management Coordination Inter-ministerial Committee is responsible for supporting the disaster management related decisions of the Government and for the harmonization of disaster management related tasks of the various ministries.

The Hungarian Nuclear Emergency Response Plan (HNERP) is maintained and regularly updated by the Higher Level Working Group consisting of the representatives of the relevant central, sectorial and regional organizations. As outcomes of these reviews, several guidelines and technical guidance documents were prepared during the recent years. The last version of the HNERP was published in November, 2011; currently, the HNERP is under review.

The county defence committees and their working bodies operate on regional and local levels. The disaster management and nuclear emergency response working committees are chaired by the chairpersons of County Defence Committees. Their tasks are the development of defence plans, county level direction of preparation, response and recovery, providing professional recommendations on response and recovery in the case of a potential or real emergency, submitting proposals, planning and organization of rescues from any aspect, as well as the direction of rescue works. The work of the chairperson is supported, as an assistant chair-person, by a disaster management expert.

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[2] Topic 5, in accordance with the authorizations established in the Atomic Act, was prepared by the Ministry of Interior - National Directorate General of Disaster Management

In normal operating state the HNERS performs the following tasks: continuous monitoring of the nation-wide radiological situation; collection, verification, analysis of radiological data, and alarming; operation and maintenance of the HNERS alerting system; updating of nuclear emergency response plans; preparation and exercising of organizations concerned in nuclear emergency response; provision of material and technical resources required for the performance of nuclear emergency response tasks.

Tasks to be fulfilled, in addition to those listed above, in alert operating state are: strengthened monitoring; forecasting of unplanned radiation exposure to the population; provision of reliable and timely information to the public on the event occurred and the nation-wide radiological situation; preparation for the commencement of the emergency operation, should it become necessary.

In emergency operating state, the HNERS performs: the assessment, mitigation and termination of the consequences of the extraordinary event inducing the nuclear emergency; forecasting of the radiological consequences of nuclear accident occurring outside the borders of the country and in space, or of a national situation induced by an event entailing radiation hazard; the determination and implementation of the tasks required by the situation. Amendment to the legislation should not be initiated.

The HNERS was established in compliance with the relevant international standards; thus it is at an internationally recognized level.

## *5.3 Radiation protection*

The National Radiation Monitoring and Alarming System (NRMAS) is operated to provide decision making support to the governmental coordination body. The operation of the NRMAS and the direction of its professional work are performed by the minister responsible for disaster management.

The leading organ of the NRMAS is the Nuclear Accident Information and Evaluation Centre, which performs the central tasks of early forecasting in the case of a nuclear emergency and of the international radiological monitoring data exchange system; additionally it provides contribution to public information, support to decisions made by the governmental coordination organization; forecasts the expected dispersion route of radioactive materials discharged from an event having adverse safety influences; operates the international real-time on-line nuclear emergency decision support system.

A sub-system of the NRMAS consists of the installed automatic remote measurement stations of the Radiological Remote Measurement Network, which is the early warning system in the case of a nuclear emergency; the system continuously monitors the radiation dose-rate in the county and the more important meteorological parameters. Currently, gamma dose rate measurement data from 132 measuring stations of six sectors are collected in the national radiological monitoring centre. The network of mobile radiological laboratories means the other sub-system of the NRMAS, which identifies and analyses the radiation contamination in the case of a nuclear emergency. The third sub-system of the NRMAS is the network of fixed laboratories, which measure the radioactivity of the collected samples (i.e. food, milk, soil, water, etc.). These measurements provide basis for the implementation of long-term protective measures (i.e. grazing ban, limitation of food and water consumption, etc).

The operation of the radiation protection monitoring systems under the direction of the Minister of the Interior is regulated by Ministerial decree 7/2012. (III. 7.) BM. No justification for further amendment to the legislation is revealed.

## 5.4 *External resources and tools that can be utilized for on-site emergency response*

The chairperson of the Emergency Response Organization of the nuclear power plant, if needed, can request external resources for the response. At the same time, the chairperson of the organization leading the national level emergency response can send forces to support on-site emergency management, if he/she judges that the nuclear power plant is not able to manage the situation with its own resources.

External forces are involved in fire fighting and technical rescue, depending on the severity of the occurred situation.

Detailed data, on mobile equipment available at the administrative and national economy organizations for the provision of the electric supply and internal energy supply to the Paks NPP, is included in the survey conducted by the Directorate General for National Disaster Management in the frame of the Targeted Safety Re-assessment. This data primarily refers to the capacity, number, location and activation time (i.e. taking them to transportable condition, their transportation and putting into service) of the available Diesel generators, pumps and fuel transportation vehicle. The vehicles for the transportation or hauling of the generators are selected by the competent disaster management organizations. Operators are available for the generators and pumps requiring special operatory knowledge.

The equipment can be air transported by helicopters of the Hungarian Defence Forces; however air transportation requires the lifting of the air ban around the plant.

## 5.5 *Protective actions*

The three counties within the Urgent Protection Action Zone (i.e., the area within the 30 km radius around Paks NPP) are: Bács-Kiskun, Fejér and Tolna Counties. They fulfil their response tasks according to their regional and local emergency response plans.

### *5.5.1 Iodine prophylaxis*

The necessary stock of iodine tablets for the citizens of the settlements within 30 km radius of Paks NPP are provided and maintained by the Medical Stock Management Institute. The tablets are stored in the offices of the local governments concerned, at the family doctors and the duty services of first responder organizations. Following the receipt of a decision on the distribution of iodine tablets, the professionals of the Public Health Professional Body of the County Government Office performs the iodine tablet distribution.

### *5.5.2 Evacuation of the workers of Paks Nuclear Power Plant*

The evacuation plan of the workers of Paks NPP is included in the General Emergency Response Plan of the plant. According to the plan, the employees should use their own vehicles, the train owned by Paks NPP and the buses put at the disposal of the plant by the regionally competent bus company.

### *5.5.3 Evacuation and reception*

As a part of the emergency response plan, the disaster management organizations established evacuation and reception plans for the public. The reception of the affected population can be arranged, should the evacuation be ordered.

### *5.5.4 Provision of the public with protection tools*

The protection breathing tools (protective hoods) required for the rescue and evacuation are available for those living in settlements located in the dispersion route of the radioactive plume; the protective hoods are distributed at the meeting points.

The protective hoods are stored in the settlements' warehouses for those living within a 9 km radius of the plant; the rest of the stock is stored in the county warehouses (outside of the 30 km zone); the latter are distributed based upon the local effects of the nuclear emergency situation.

## *5.6 Alerting the public, public information*

### *5.6.1 Alerting the public*

Within the 30 km radius of Paks NPP, the technical tool of alerting is the installed public information and alerting system. Altogether 227 modern public information and alerting devices alert about 225,000 people living in 74 settlements on 2,800 square kilometres.

The acoustic terminals are powered by uninterruptible power supplies, thus the public can be alerted and informed in the case of loss of the electrical power supply. The high capacity loud speakers, in addition to traditional siren signals, are appropriate to transmit voice messages, thus the population can be provided with the essential information by way of live broadcasts.

The control centres of the system are installed at the Protected Command Centre, Plant Control Centre and at the Tolna County Disaster Management Directorate; additionally, a mobile control unit is available.

The operability of the sirens is tested by humming signals (i.e. at reduced volume) on the first Monday of each month, and by transmitting a full loud emergency hazard along with end of emergency signals twice a year.

### *5.6.2 Public information*

As required by Govt. decree 165/2003. (X.18.) Korm. on the rules of public information in the case of a nuclear or radiological emergency, public information plan shall be prepared at national, sectorial, county and facility levels by the central bodies and organizations of the HNERS, as well as by those bodies and organizations that are obliged to prepare Emergency Response Plans. The public information plans are to be prepared for providing timely and reliable information to the public; the plans include those available information principles, methods and tools, which can be applied for effective communication.

## *5.7 Preparation, training and exercising of organizations participating in emergency response*

The training and exercising of those having roles in national level emergency response are organized in line with Govt. decree 167/2010. (V.11.) Korm. on the Hungarian nuclear emergency response system. The Training and Exercise Working Committee prepares the annual Training and Exercise Plan, which is then endorsed by the Disaster Management Coordination Inter-ministerial Committee (DMCIC). This annual Plan establishes the major training and exercise programmes for the subject year and the major directions for the subsequent year. It includes the minimum required training and exercise activity, with the consideration of the Long-Term Training and Exercise Plan. The DMCIC, by endorsing the plan, identifies the expectations for the central, sectorial, regional and local organizations of the HNERS. The tasks included in the plan shall then be integrated into the individual Training and Exercise Plans of the HNERS organizations.

A conduct and evaluation plan is prepared for each exercise. The exercises shall be evaluated in line with the viewpoints defined in advance in the conduct and evaluation plan. Based on the evaluation of an exercise, an action plan is established in order to eliminate the identified non-compliances and deficiencies; the progress of the implementation of the actions shall be monitored by the organizations concerned.

### *5.8 Summary*

The experience gained from the TSR and the Fukushima accident has not revealed any such deficiency in the field of off-site emergency preparedness and response, which requires the modification of the Hungarian disaster management system or that of the Hungarian nuclear emergency response system. Following the completion of the international review, based on its outcomes, Hungary will re-assess the need for modifications and, if appropriate, take the necessary steps.

## Topic 6: International cooperation

### *6.1 Strengthening the peer review process of CNS and of missions (IAEA, WANO and Industry)*

This issue is in relation to Theme a) of Topic 6 of the 2nd Extraordinary Review Meeting of the CNS.

Hungary will provide information in the CNS national reports on the results of the review missions conducted in the field of nuclear safety, and will offer monitoring of the progress of the implementation of their recommendations.

Hungary, with its own resources, supports the development of the effectiveness and scope of the international nuclear safety expert missions, as well as the enhancement of the coordination between different missions.

Hungary takes part in the improvement of the processes and effectiveness of the CNS, and in the improvement of the reviews conducted in the frame of the CNS.

After the Chernobyl accident, Hungary participated in the safety re-assessment of the Russian design nuclear power plants built based on Russian design, the lessons learned were integrated into the legislation and the safety improvement programme of the nuclear power plant.

### *6.2 Optimization of the global safety regime*

This issue is in relation to Theme b) of Topic 6 of the 2nd Extraordinary Review Meeting of the CNS.

Hungary, with its own resources, supports the rationalization of the responsibility and task sharing between certain international organizations and welcomes those initiatives, which aim at limiting and optimizing the duplication of tasks being in connection with international cooperation.

Hungary studies the potential participation in the establishment of a regional crisis centre.

### *6.3 Strengthening communication mechanisms through regional and bilateral cooperation*

This issue is in relation to Theme c) of Topic 6 of the 2nd Extraordinary Review Meeting of the CNS.

Hungary, with its own resources, supports the enhancement of nuclear safety and the nuclear safety regulatory system in countries opting for nuclear energy; Hungary participates in the related activities of the international organizations.

In the field of nuclear safety, Hungary maintains bilateral cooperation with the neighbouring countries. In meetings organized in the frame of these cooperation agreements, Hungary provides information on nuclear safety related information and events.

Hungary is a member of the WENRA Mutual Assistance Working Group, which aims at enhancing the cooperation between nuclear safety authorities in the case of a nuclear accident.

## *6.4 Effectiveness of experience feedback mechanisms*

This issue is in relation to Theme d) of Topic 6 of the 2nd Extraordinary Review Meeting of the CNS.

Hungary takes part in all fora serving for the exchange of experiences in the field of nuclear safety (i.e., IRS, INES, WANO, EU Clearinghouse, VVER Forum) and strives to utilize the experience gained from other sources as well.

The HAEA participates in the working groups aiming at utilizing the lessons learned from the Fukushima Daiichi accident, as follows:

- ENSREG (HAEA is represented at high management level),
- ENSREG nuclear safety working group (WG1),
- WENRA reactor harmonization working group,
- WENRA mutual assistance working group,
- WENRA accident management working group,
- EU nuclear security ad-hoc working group,
- IAEA Action Plan – occasionally, participation in regular IAEA working groups and activities,
- IAEA CNS – Hungarian delegation participates in the extraordinary and regular review conferences,
- OECD NEA WGOE working group.

The tasks set by the above working groups are performed by the designated members, who can live with the possibility to involve other professionals.

Hungary supports striving for emphasizing the experience feedback during expert review mission.

## *6.5 Strengthening and expanded use of IAEA Safety Standards*

This issue is in relation to Theme e) of Topic 6 of the 2nd Extraordinary Review Meeting of the CNS.

Hungary fully integrates the IAEA nuclear safety fundamentals and standards into its nuclear safety legislation (see Section 4.1); Hungary constantly supports the development of these standards in order to continuously enhance nuclear safety. Hungary agrees that the prevention and consequence mitigation should be more reasonably represented among the requirements.

## Part III

In line with Reference [8] Part III would list those actions that are identified in such areas that have not been discussed in the previous topics, i.e., which cannot be grouped under previous topics (under Part I and Part II). The review has not identified the need of such actions.

# Part IV: Summary table of actions

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
|---|---|---|---|---|---|---|---|---|
| | 1. | Natural hazards | | | | | | |
| 1. | 1.1. | Recurrence frequency taken into account in the design basis | Considering natural hazards of 10 thousand year recurring frequency. For earthquake, flooding and low water level of Danube. | Successful termination of assessments in December, 2011. No open task in this area. | | Task completed. | 2.1.1 | 3.1.1 |
| 2. | 1.2. | Secondary effects of earthquakes | 1 - Interventions to protect the personnel and equipment in the fire brigade barrack, which is made of reinforced concrete, but has not yet been seismically qualified. | | 1.2. | 15.12.2015. | 2.3.3, 3.1.1 | 3.1.2 |
| 3. | | | 2 - The demineralised water tanks in Installation II that play an important role in ensuring demineralised water stocks are located in the direct vicinity of the medical and laboratory building. The walls of the building shall be seismically qualified and, if necessary, | | 1.9. | 15.12.2015. | 2.1.2 | 3.1.2 |

[3] All references to these serial numbers are in [<xx>] form

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
|---|---|---|---|---|---|---|---|---|
| | | | reinforced or provide appropriate protection of the tanks by other means. | | | | | |
| 4. | | | 3 - The underground lines and connections (pipelines, cables) at risk due to potential settlement of the main building shall be re-qualified and, if necessary, modified to allow for a relative displacement. | According to the current conservative analyses, soil liquefaction might occur in the acceleration ranges slightly exceeding the design basis, which can cause an uneven settlement of the buildings. | 1.11. | 15.12.2017. | 2.2.1.1 | 3.1.2 |
| 5. | | | 4 - A state-of-the-art analysis shall be performed for the proper assessment of the existing margins of earthquake-initiated building settlement and soil liquefaction phenomenon. | | 1.45. | 15.12.2018. | 2.2, 2.2.1.1. | 3.1.2 |
| 6. | 1.3. | Protected volume approach | 1 - The water penetration through the walls would accumulate in a sump and a permanently installed sump pump can remove it. Modification of the wall penetrations to a sealed design shall be carried out. | Certain wall penetrations in the machine room of essential service water pumps are not provided with water sealing, so flooding of the machine room may occur if a beyond design basis flood takes place. | 1.4. | 15.12.2015. | 3.1.2 | 3.1.3 |
| 7. | | | 2 - Automatic shutdown of the | | 1.10. | 15.12.2015. | 2.1.2 | 3.1.3 |

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
|---|---|---|---|---|---|---|---|---|
| | | | main condenser coolant pumps shall be provided when the condenser pipeline is damaged due to earthquake or other reason. It shall be ensured that the pipeline trenches are applicable to receive and drain the discharged water. If necessary, the slope shall be elevated or a protective dam shall be constructed to avoid the flooding of the turbine hall or the cable tunnels. | | | | | |
| 8. | | Safety culture | Fixing of the non-process equipment and tools that could adversely impact process equipment during outages shall be provided. | | 1.3. | 15.12.2014. | 2.1.2. and 2.2.4. | |
| - | 1.4. | Early warning notifications for extraordinary natural impacts | No action necessary. | Taking into account the relatively small size and geographical situation of Hungary, the current practice is satisfactory from every aspect and no task has been identified. | | - | | 3.1.4 |
| 9. | 1.5. | Seismic monitoring system | In the frame of the reconstruction project of seismic instrumentation, which | Currently no such system exists, which would initiate an automatic shutdown of | 1.1. | 31.12.2012. | 2.1.2; 2.1.2., 2.2.1., | 3.1.5 |

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
|---|---|---|---|---|---|---|---|---|
| | | | is in the preparatory phase, the question of automatic shutdown shall be revisited. | the reactors for a given acceleration level. | | | 2.2.4., 6. and 7.3. | |
| - | 1.6. | On-scene inspections, qualified walkdowns | A regular activity is going on, it is not necessary to modify the current practice. | If specific international standards, requirements become available for such inspections and walkdowns, both the authority and the licensee shall adopt and apply them. | | - | | 3.1.6 |
| - | 1.7. | Flooding margin assessments | No action necessary. | The stress test assessment determined that the site of Paks NPP is not prone to flooding. | | - | | 3.1.7 |
| - | 1.8. | Assessment of external hazard margins | The latest Periodic Safety Review dated to 2008 required new, supplementary analyses. | Evaluation of loads caused by weather impacts is not in compliance with the modern expectations. | | 31.12.2012. | | 3.1.8 |
| 10. | | Further tasks independent of the above expectations | 1- The existing symptom-based emergency operating procedures shall be reassessed as to whether they support an optimal recovery in such combined situation. | Due to implications from Fukushima Daiichi accident, such improbable, complex cases shall also be taken into account as extension of the design bases. | 1.21. | 15.12.2013. | 2.1.2. | |
| 11. | | | 2 - Protection of the not seismically reinforced 400 kV and 120 kV substations and the | The 400 kV and 120 kV substations though not safety systems and not | 1.6. | 15.12.2014. | 2.2.1.2, 5.1.1.3, 5.1.5, 5.2.5 | |

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
|---|---|---|---|---|---|---|---|---|
| | | | automatisms switching the plant to isolated operation against earthquakes shall be evaluated and increased if necessary. | seismically reinforced, might provide many alternative electric supply opportunities, if they are not damaged. | | | and 5.3.1, 2.1.2., 2.2.1., 2.2.4., 6. and 7.3. | |
| 12. | | | 3 – Periodic inspection, maintenance and operational testing of the equipment to be applied in case of low water level of the Danube shall be supplemented. The respective, missing inspection, testing and maintenance instructions shall be developed. | During the stress test the plant identified that the maintenance and inspection procedures to be applied in the situation of extreme low level of the Danube were not satisfactory | 1.24. | 15.12.2013. | 5.2.2; 5.2 | |
| 13. | | | 4 – A list of such system components important to safety, which are endangered by electromagnetic effects (including the effects induced by lightning) shall be compiled and display whether a given component is adequately qualified. | Based on the list the authority and the licensee can specify reinforcements and corrective actions. HA5444-1.2.3 | 1.42. | 15.12.2015. | | |
| 14. | | | 5 - It shall be analyzed if the lack of seismic qualification of the machine racks and travelling water band screens | | 1.41. | 15.12.2015. | 2.1.2., 2.2.1., 2.2.4., 6. and 7.3. | |

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
|---|---|---|---|---|---|---|---|---|
| | | | of the essential service water system jeopardizes the ultimate heat sink function and, if necessary, the adequate exclusion measures shall be implemented. | | | | | |
| | 2. | **Design issues** | | | | | | |
| 15. | 2.1.1. | Application of means providing alternate cooling and heat sink | 1- The operator shall maximize the available inventory of the stored demineralised water in all operation states. | | 1.7. | 15.03.2014. | 5.2.5 | |
| 16. | | | 2- Access to the connection point of the auxiliary emergency feedwater system in accident conditions shall be improved, new connection points shall be established on the demineralised water tanks. | | 1.14. | 15.12.2015. | 5.2.5 | |
| 17. | | | 3- The potential setting of the boron concentration of water inventories from external sources and its storage shall be solved and supply mode of borated water inventories to the containment shall be regulated in an operating instruction. | | 1.15. | 15.12.2018. | 5.2.5 | |
| 18. | | | 4- By provision of appropriate electrical power supply it shall | | 1.17. | 15.12.2015. | 5.2.5, 5.1.1.3, | |

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
|---|---|---|---|---|---|---|---|---|
| | | | be established that the bank filtered well plant, which can be used irrespective of the water level of the river, be able to supply water to the essential service water system via the existing connections in accident situations. | | | | 5.1.5, 5.2.5 and 5.3.1. | |
| 19. | | | 5- The accessibility of the water reserve available in the closed segment of the discharge water canal for the earthquake resistant fire water pump station of Installation II that is equipped with individual diesel power supply shall be solved. | | 1.18. | 15.12.2018. | 5.2.5 | |
| 20. | | | 6- Similar to the connection existing on Installation I, the water supply shall be solved also for Installation II from the fire water system to the essential service water system through the technology cooling water system. | | 1.19. | 15.12.2015. | 5.2.5 | |
| 21. | | | 7- The equipment necessary for the cooling water supply to at least one diesel generator of | | 1.20. | 15.12.2015. | 5.2.5, 5.1.1.3, 5.1.5, 5.2.5 | |

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
|---|---|---|---|---|---|---|---|---|
| | | | each unit from the fire water system shall be provided and the operating instruction shall be completed with the measures to be implemented. | | | | and 5.3.1. | |
| 22. | 2.1.2. | Enhancement opportunities of on-site and off-site AC power supply | 1- Utilizing the fuel storage capacity of the safety diesel generators the amount of diesel fuel to be stored shall be increased and this shall be incorporated in an administrative procedure. | | 1.5. | 15.03.2014. | 5.1.1.3, 5.1.5, 5.2.5 and 5.3.1. | |
| - | | | 2- See: [<11>] | | | 30.09.2013. | 2.2.1.2, 5.1.1.3, 5.1.5, 5.2.5 and 5.3.1. | |
| 23. | | | 3- Power-operated filters of the essential service water system shall be established. | | 1.8. | 15.12.2015. | 5.1.1.3, 5.1.5, 5.2.5 and 5.3.1. | |
| 24. | | | 4- Appropriately protected independent severe accident diesel generator(s) shall be installed after assessment of the necessary number and capacity, and determination of the design requirements | | 1.12. | 15.12.2018. | 5.1.3; 5.1.1.3, 5.1.5, 5.2.5 and 5.3.1. | |

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
|---|---|---|---|---|---|---|---|---|
| | | | including beyond design basis hazards. | | | | | |
| 25. | | | 5- Out of the two power plants being able to supply external electric power via dedicated lines, the black-start capability (start-up from own diesel generator) shall be created for the Litér gas turbine. | | 1.13. | 15.12.2014. | 5.1.1.2, 5.1.1.3, 5.1.5, 5.2.5 and 5.3.1. | |
| 26. | | | 6- Procedures shall be developed for the use of the possible, but currently not applied cross-links between the units for normal operation and for the backup and safety buses. | | 1.22. | 31.07.2013. | 5.1.1.3, 5.1.5, 5.2.5 and 5.3.1. | |
| 27. | | | 7- Possible cross-links shall be studied and the concluding modifications shall be carried out for providing safety electrical power supply from any operable emergency diesel generator in any unit to the safety consumers of any other unit. | | 1.23. | 15.12.2015. | 5.1.1.3, 5.1.5, 5.2.5 and 5.3.1. | |
| - | 2.1.3. | Enhancement opportunities of DC power supply. | No action necessary. | | | | | |

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
|---|---|---|---|---|---|---|---|---|
| - | 2.1.4 | Operational and preparatory actions. | Respective actions are discussed in Topic 1 and/or Topic 3. | | | | | |
| - | 2.1.5 | Instrumentation and monitoring. | Respective actions are discussed in Topic 1 and/or Topic 3. | | | | | |
| - | 2.1.6 | Shutdown improvements | Discussed in Section 2.1.17 and Topic 3. | | | | | |
| - | 2.1.7 | Reactor coolant pumps seals | Not relevant for VVER-440/213 | | | | | |
| - | 2.1.8 | Improvement of ventilation capacity in total loss of power supply. | Section 2.1.2. of [3] dealt with the provision of AC power supply. No separate action was necessary except for the Protected Command Centre, which is discussed under Topic 3. | No separate action was necessary except for the Protected Command Centre. | | | | |
| - | 2.1.9 | Improvement of main and backup control rooms for long term habitability after a total loss of power | Tasks were only identified for emergency command centres, which are discussed under Topic 3. | | | 15.12.2018. | | |
| - | 2.1.10 | Improvement of robustness of spent fuel pools for various events. | Respective actions are discussed in Topic 1 and/or Topic 3. | | | | | |

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
|---|---|---|---|---|---|---|---|---|
| - | 2.1.11 | Improvement of separation and independence of safety systems. | Timely shut down the large diameter and large flow-rate condenser cooling water systems, if damaged, to avoid flooding of safety systems. Identical to [<7>]. | | | 15.12.2015. | 2.1.2. and 2.2.4. | |
| - | 2.1.12 | 2.1.12 Flow path and access availability. | | Instead of maintenance of routes with special tools, actions rather meant to ensure parallel, diverse water and electric power supply routes were decided during the stress test. | | | | |
| - | 2.1.13 | Provision of mobile devices and their adequate storage. | Respective actions are discussed in Topic 1 and/or Topic 3. | | | | | |
| - | 2.1.14 | Bunkered/hardened systems. | Respective actions are discussed in Topic 1 and/or Topic 3. | | | | | |
| - | 2.1.15 | Improvement of response capability to multiple accidents on the site. | Respective actions are discussed in Topic 1 and/or Topic 3. | | | | | |
| - | 2.1.16 | Equipment inspection and training programmes. | Respective actions are discussed in Topic 1 and/or Topic 3. | | | | | |
| 28. | 2.1.17 | Further studies to | Probabilistic assessment for | | 1.43. | 31.12.2012. | 2.2.1., | |

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
|---|---|---|---|---|---|---|---|---|
| | | address uncertainties. | closed reactor states under 150 °C primary circuit temperature, whether a time limit considering the balanced distribution of risk is reasonable to be established and introduced and actions [<9>], [<11>], [<10>], [<18>], [<5>]. | | | | 5.2.4. and 5.2.5; 2.1.2., 2.2.1., 2.2.4., 6. and 7.3. | |
| | **3.** | **On-site emergency response, accident management and recovery** | | | | | | |
| - | 3.1.1 | Compliance with WENRA reference levels | After completion of amendment of WENRA reference levels the missing requirements will be incorporated in the nuclear safety regulations. | | | 15.12.2018. | | 3.3.1 |
| - | 3.1.1.1 | 3.1.1.1 Hydrogen mitigation in the containment | One of the technical modifications was the installation of hydrogen recombiners in the containments designed to cope with severe accidents, which were installed for all of the 4 units before the end of 2011. No action necessary. | | | 31.12.2011. | | 3.3.1 |

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| 29. | 3.1.1.2 | Hydrogen monitoring system | Installation of hydrogen monitoring system as part of the severe accident instrumentation for units 3 and 4. | Installation of a hydrogen monitoring system as part of the severe accident instrumentation has already been completed for units 1 and 2, while it will be completed in 2013 and 2014 for units 3 and 4 respectively. | | 15.12.2013. | 6.3.7 | 3.3.1 |
| - | 3.1.1.3 | Reliable depressurization of the reactor coolant system | Installation of the severe accident diesel generators has taken place for Paks NPP in the frame of severe accident management actions for all 4 units of the plant. No action necessary. | | | | | 3.3.1 |
| 30. | 3.1.1.4 | Containment overpressure protection | The system that is able to prevent the long-term, slow over-pressurisation of the containment shall be developed and implemented. | Paks NPP prepared the concept for the implementation, which recommends the installation of an active cooling system. | 1.25. | 15.12.2018. | 2.1.2., 2.2.1., 2.2.4., 6. and 7.3.; 6.3.3 | 3.3.1 |
| 31. | 3.1.1.5 | Molten corium stabilization | Among the severe accident management measures Paks NPP selected the strategy of in-vessel maintenance of the molten core. No further action is necessary. | The molten core can be stabilized within the reactor pressure vessel by flooding the reactor cavity and external cooling of the vessel. The respective | | 31.12.2014. | 6.5.3 | 3.3.1 |

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| | | | | modification has already been implemented for unit 1 and unit 2, while it will take place in 2013 and 2014 during the refuelling outages of unit 3 and unit 4 respectively. | | | | |
| - | 3.1.2. | Severe accident management hardware provisions | 1 - Appropriately protected independent severe accident diesel generator(s) shall be installed after assessment of the necessary number and capacity and determination of the design requirements including beyond design basis hazards. Identical to [<24>]. | The concept document prepared for the action contains the installation of 1-1a diesel generator for both Installation I and II, the capacity of which is enough to supply one safety train. | | 15.12.2018. | | 3.3.2 |
| - | | | 2 - By provision of appropriate electrical power supply it shall be established that the bank filtered well plant, which can be used irrespective of the water level of the river, be able to supply water to the essential service water system via the existing connections in accident situations. Identical to [<18>]. | The nuclear power plant has 9 wells each having a large diameter and a depth of 30 m that are bored in the pebble bed of the Danube; these wells are permanent water sources providing an unlimited quantity of water independently of the water level of the Danube. | | 15.12.2015. | | 3.3.2 |
| 32. | | | 3 - A new water supply route | | 1.16. | 15.12.2018. | 1.2.2. and | 3.3.2 |

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
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| | | | connected in the courtyard by flexible means shall be constructed that is protected from external hazards (such as earthquake). The spent fuel pool shall be filled from the borated water reserve specified previously via this line. The required operations shall be specified in procedures. | | | | 2.1.2. | |
| 33. | | | 4 - Corresponding to management of severe accidents, for the construction of an external water supply route to the auxiliary emergency feedwater system, the equipment necessary for the connection of external origin mobile diesel generators and pumps to the systems shall be purchased. | | 1.35. | 15.12.2016. | 5.2.5; 5.1.1.3, 5.1.5, 5.2.5 | 3.3.2 |
| 34. | 3. 1.3. | Review of SAM Provisions Following Severe External Events | Severe accident situations simultaneously taking place in the reactor and the spent fuel pool shall be managed by the development of a severe accident management guideline. Technical | The guidelines enter into force in the various units, when the respective technical modifications are completed: by the end of 2012 regarding unit 1 and unit 2, while in 2013 and | 1.26. | 15.12.2018. | 1.2.2, 2.1.2. | 3.3.3 |

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| | | | modifications generated by the implementation of other actions shall be implemented in the concerned SAMG. | 2014 in unit 3 and unit 4, respectively. | | | | |
| 35. | | | The method of usage of external supply opportunity shall be described in instruction documents. | | 1.36 | 15.12.2017. | 1.2.2, 2.1.2. | 3.3.3 |
| 36. | 3. 1.4. | Enhancement of Severe Accident Management Guidelines | The physical arrangement and instrumentation of the Technical Support Centre established at the Protected Command Centre shall be extended to provide sufficient resources for simultaneous management of severe accidents occurring on more than one (even all 4) units. | | 1.38. | 15.12.2018. | 6.3.8 | |
| 37. | | | The structure of the organization responding to accidents affecting multiple units and the number of staff shall be determined; procedures shall be developed for personnel and equipment provisions, as well as for shift changes. | | 1.37. | 15.12.2017. | 6.3.8 | |
| - | | | Paks NPP initiates the | | | 15.12.2014. | 5.1.1.3, | 3.3.4 |

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| | | | establishment of black-start capability (start-up from its own diesel generator) for the Litér gas turbine. Identical to [<25>]-el. | | | | 5.1.5, 5.2.5 and 5.3.1. | |
| - | 3. 1.5. | Validation of enhanced severe accident management guidelines | No separate task is necessary | As the result of the verification the guidelines have been introduced for unit 1. A similar verification would take place after any supplementation or enhancement of the guidelines. | | | | 3.3.5 |
| - | 3. 1.6. | Severe accident exercises | The scenario of the exercise shall make it possible to practice the implementation of on-site organizational and technical measures in severe accident situations. No action was determined in this area. | According to the Hungarian legislation the emergency response organization of the NPP is required to carry out a full-scale nuclear emergency exercise every year that involves the whole personnel of the organization. | | | | 3.3.6 |
| 38. | 3. 1.7. | Training of severe accident management | The training and exercise of multi unit emergencies can take place after the implementation of that action. | By the introduction and implementation of severe accident management guidelines and | 1.39. | 15.12.2017. | 6.1.6 | 3.3.7 |

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
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| | | | A software-based severe accident training simulator shall be developed. In the first stage of the two-stage development the current simulator will be extended for the education of the staff of Technical Support Centre, while later it will be extended to train a wider scope of the users. | modifications the operator also introduced the training of severe accident situations to the scope of emergency response exercises. | | | | |
| - | 3. 1.8. | Extension of severe accident management guidelines to all plant states | Already implemented. | The severe accident management guidelines cover the low power and shutdown mode of the reactor, as well as the severe accident situation of the spent fuel pool. | | | | 3.3.8 |
| 39. | 3. 1.9. | Improvement of communication | 1 - Conditions for radio communication shall be assessed in the case of permanent loss of electric power and earthquakes and the necessary actions shall be performed. | | 1.30. | 15.12.2018. | 2.1.2., 2.2.1., 2.2.4., 6. and 7.3. | 3.3.9 |
| 40. | | | 2 - Informatics mirror storage computers shall be installed both at the Protected Command | | 1.31. | 15.12.2016. | 6.1.2.4. | 3.3.9 |

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
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| | | | Centre and the Backup Command Centre containing the necessary scope of data. | | | | | |
| 41. | 3. 1.10 | Presence of hydrogen in unexpected places | Distributions using less conservative, three-dimensional analyses beyond the use of the lumped-parameter models shall be performed. Need for further action will be resultant on the analysis. | According to the calculation results inflammable concentrations may occur, which can lead to turbulent burning. | 1.46. | 31.12.2012. | 2.2.1., 5.2.4. and 5.2.5; 2.1.2., 2.2.1., 2.2.4., 6. and 7.3; 6.3.8. | 3.3.10 |
| 42. | 3. 1.11 | 3.1.11 Large volumes of contaminated water | Procedures shall be developed for the management of liquid radioactive wastes during severe accidents. The risk, potential routes and possible monitoring tools and methods of liquid form release of radioactive materials shall be examined and the measures necessary and possible to respond to in such a situation shall be specified. | The plant is not fully prepared to manage liquid radioactive wastes generated in large quantities during a severe accident. | 1.40. | 15.12.2015. | 2.1.2., 2.2.1., 2.2.4., 6. and 7.3; 6.1.3.3. | 3.3.11 |
| 43. | 3. 1.12 | Radiation protection | 1- Procedures for collecting and transporting emergency response personnel shall be developed and the necessary | The goal is to improve the access in severe accident conditions impaired by the adverse radiation | 1.32. | 15.12.2017. | 6.1.3.5. | 3.3.12 |

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| | | | means and rules of their provision shall be determined. | conditions. | | | | |
| 44. | | | 2- A shielded transport vehicle deployable at significant radiation levels shall be procured. | | 1.33. | 15.12.2018. | 6.1.3.5. | 3.3.12 |
| 45. | | | 3- The rules for exemptions from the air ban around the plant shall be modified to manage airborne support. | | 1.34. | 15.12.2014. | 6.1.3.5. | 3.3.12 |
| 46. | | | 4- The applicability of fixed radiation monitoring devices installed on, and in the vicinity of, the site to support emergency response activities after an earthquake and total loss of power shall be assessed. | | 1.44. | 15.12.2014. | 2.1.2., 2.2.1., 2.2.4., 6. and 7.3; 4.2.1.5 | 3.3.12 |
| 47. | 3. 1.13 | On-site emergency centre | 1- Seismic qualification of the on-site shelters not yet qualified shall be performed and non-earthquake resistant equipment in the shelters shall be improved. A nuclear emergency response centre resistant to earthquakes of a peak ground acceleration higher than design basis earthquake shall be established. | | 1.27. | 15.12.2016. | 4.2.1; 5.1.3 | 3.3.13 |

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| 49. | | | 2- Air-conditioning of the Protected Command Centre shall be re-assessed and an appropriate power equipment shall be installed that can also be supplied by diesel generator. | | 1.29. | 15.12.2015. | 5.1.3. and 4.2.1; 2.1.2. | 3.3.13 |
| 49. | | | 3- A Backup Command Centre that complies with protection requirements, and is equivalent with the Protected Command Centre in terms of management and communication, shall be established. | | 1.28. | 15.12.2017. | | 3.3.13 |
| - | 3. 1.14 | Support to local operators | The plant is duly prepared for getting support from external forces in severe accident situation. No further action is necessary. | | | | | 3.3.14 |
| - | 3. 1.15 | Level 2 probabilistic safety analysis | No action necessary. | Paks NPP has Level 1 and Level 2 PSA assessment for each operating mode of the reactors and the spent fuel pools. | | | | 3.3.15 |
| - | 3. 1.16 | Severe accident analyses | No action necessary. | | | | | 3.3.16 |

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| | **4.** | **National organizations** | | | | | | |
| 50. | 4.1. | Review of nuclear and/or radiation protection laws, requirements and recommendations | The laws on regulatory supervisory activity, as well as the independence of the authority and the existence of conditions required for regulatory supervisory activity, should be revised in the mirror of the lessons learned. | Another important source of the amendment to laws can be the supplementation of the WENRA reference levels, which may be established in 2013. Additionally, the amendment to nuclear safety regulations can be required by the revisions of IAEA recommendations and the EU nuclear safety directive; however their realization is a future issue. | | 15.12.2016 | | |
| - | 4.2. | Changes in the role and responsibility of the authority | No action is needed. | At the request of the Government of Hungary, the performance of the Authority will be reviewed by the IAEA IRRS mission in 2014. | | | | |
| 51. | 4.3. | National review of emergency response activity, and developments | One of the main objectives of the national exercise planned to be organized in the first half of 2013 is to practice media communication, as well as to | | | 15.12.2013 | | |

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| | | | practice the execution of certain protective actions with the participation of the invited representatives of the public. | | | | | |
| - | 4.4. | Steps in the area of openness, transparency and communication | No action is needed. | | | | | |
| - | 4.5. | Post-Fukushima safety re-assessment and action plan | No action is needed. | The Authority ordered the scheduled execution of the required safety improvement measures, and continuously verifies and evaluates the progress of execution. | | | | |
| - | 4.6. | Human and organizational factors | No action is needed. | | | | | |
| - | **5.** | **Off-site emergency preparedness and response** | Currently, no task is needed to be set. | After the conclusion of the international review, based on their results, Hungary will re-assess the need for modifications and be ready to take the necessary actions. | | | | |
| | **6.** | **International cooperation** | | | | | | |

| Task[3] | | Topic | Action | Comment | Identifier in the HA5589 resolution [12] | Final deadline | TSR national report [3] reference | ENSREG report [9] reference |
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| - | 6.1. | Strengthening the effectiveness of the CNS process and other missions | It is a continuous activity; no additional action is needed. | | | | | |
| - | 6.2. | Optimization of the global safety environment | It is a continuous activity; no additional action is needed. | | | | | |
| - | 6.3. | Strengthening the communication on a regional and bilateral basis | It is a continuous activity; no additional action is needed. | | | | | |
| - | 6.4. | Improving the effectiveness of experience feedback | It is a continuous activity; no additional action is needed. | | | | | |
| - | 6.5. | Development of IAEA safety standards and extension of their application | It is a continuous activity; no additional action is needed. | | | | | |

*Note*: 4 actions out of the 51 numbered actions have been accomplished or will be accomplished by the end of 2012.

## References


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[2] Requirements for the Technical Scope of the Targeted Safety Reassessment (TRS) of Paks Nuclear Power Plant, HAEA, May 24, 2011.
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[3] National Report of Hungary on the Targeted Safety Re-assessment of Paks Nuclear Power Plant, HAEA, December 29, 2011.
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[4] Post-Fukushima "STRESS TESTS" of European Nuclear Power Plants– Contents and Format of National Reports, HLG_p(2011-16)_85
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[5] Hungary, Peer review country report of Stress tests performed on European nuclear power plants
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[6] Extraordinary National Report for the Convention on Nuclear Safety, 2012
http://www.haea.gov.hu/web/v2/portal.nsf/download_en/67EB13B9A529E00DC1257A280023F2FD/$file/CNS_HUN_with_table.pdf

[7] Final Summary Report, 2nd Extraordinary Meeting of the Contracting Parties to the Convention of Nuclear Safety, 27-31 August 2012, Vienna, Austria
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[9] Compilation of recommendations and suggestions, Peer review of stress tests performed on European nuclear power plants, ENSREG, 26/07/2012
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[10] Authority resolution on the termination of regulatory inspection on the targeted safety reassessment of Paks NPP, HAEA docket number: OAH-01170-0003/2011-EH, Resolution number: HA5444. HAEA, December 29, 2011.

[11] Action plan of Paks NPP on the implementation of tasks identified during the targeted safety reassessment, HAEA docket numbers: OAN-01384-0001/2012, OAH-01384-0003/2012 and OAH-01384-0009/2012.

[12] Authority resolution on the implementation of action plan of Paks NPP, HAEA docket number: OAH-01384-0010/2012-EH, Resolution number: HA5589 HAEA, December 17, 2012.