REPUBLIC OF HUNGARY

NATIONAL REPORT

Document prepared in the framework of the
Convention on Nuclear Safety

Third Report, 2004

CONTENTS

SUMMARY

The Republic of Hungary was one of the first nations to sign the Convention on Nuclear Safety (hereafter referred to as the Convention) concluded in Vienna on 20 September 1994 within the framework of the International Atomic Energy Agency.

By promulgating the Convention and introducing the related measures, the Republic of Hungary has fulfilled all the conditions in Article 4 of the Convention.

This Third National Report has been compiled by the Hungarian Atomic Energy Authority (HAEA), otherwise the Authority, 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 Second Review Meeting (Vienna, 2002).

After a brief Introduction and a declaration by the HAEA`s Director General, the National Report continues with four main parts dealing with:

- a description of existing nuclear installations (mainly Paks Nuclear Power Plant (Paks NPP) as this falls within the scope of the Convention);
- the 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);
- a survey of the Safety Analysis Report of the only Hungarian nuclear installation that falls within the scope of the Convention.

By submitting the present National Report, the Republic of Hungary fulfils its obligation of reporting stipulated under Article 5 of the Convention.

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Since the submission of the Second National Report no basic changes have taken place in Hungary. The state of the nuclear installations as well as the role and the legal position of the Authority have remained unchanged. Nevertheless, new devices have been taken into operation, new technologies have been introduced, and organizational changes have been set in train. In every case where modification has taken place, safety has been the primary consideration. Measures introduced following the recommendations of international reviews have led to further safety enhancements.

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 addressed to the Report of Hungary

It is essential to mention in this summary that a serious incident occurred at the Paks NPP 10 April 2003, in the revision shaft next to Unit 2 that had been shut down for a scheduled overhaul; the direct result of the incident was that 30 fuel-assemblies were damaged and, although negligible in its extent concerning the environmental impact, radioactive material was

released into the environment. The event was classified as INES-3 on the 7-level International Nuclear Event Scale, which was devised to facilitate public understanding.

In addition to unambiguously recognizing the severity and significance of its consequences it is also justifiable to point out that the event did not take place in the technological systems necessary for the normal service of the plant, but it occurred inside a cleaning tank designed and operated by an outside contractor, during the shutdown state of Unit 2. Thus the lessons learnt from the event have in no way changed the evaluation of the nuclear safety of the plant, as a technological installation.

A description of the event, a summary of the lessons learnt, and an outline of the planned improvement measures are included in Annex 7, although practically every chapter of the report contains relevant references concerning the incident.

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

- modification of the Act on Atomic Energy (abolishing the Hungarian Atomic Energy Commission);
- introduction and certification of the quality management system of the HAEA;
- coming into effect of the enforcement policy of the HAEA and of the enforcement procedure of the Authority at first instance;
- evaluation of seismic resistance of Paks NPP and implementation of reinforcement;
- serious incident at Paks NPP in April 2003 (during chemical cleaning of nuclear fuel outside the reactor) and its management.

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In this current report mainly the changes that have occurred since the closure of the previous document are detailed, nevertheless all the basic principles that are still valid are repeated to present the reader with a self-standing report. Important processes that remain unchanged since the submission of the Second National Report are placed in the Annexes.

The data presented in this report reflect the situation as at 31 December 2003.

During the elaboration of this report the comprehensive presentation of the status of nuclear safety in Hungary was regarded as a high priority issue. The following table shows the correspondence with the Articles of the Convention.

Article (Convention)	Chapter (National Report)
4	Summary
5	Summary
6	1.1, 4.3
7	2.1, 3.8.1, 3.9.1
8	2.2
9	2.2.4
10	2.1
11	3.3, 3.4
12	3.5
13	3.6
14	3.7
15	3.8
16	3.9
17	4.1
18	4.2

Declaration

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

The Republic of Hungary declares that nuclear safety is given priority in all aspects 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 its licensing and inspection activities,*
- *the operator is committed to the priority and continuous improvement of safety concerning the activities it carries out.*

Budapest, 2004.

Dr. József Rónaky
Director General of the Hungarian Atomic Energy

INTRODUCTION

National energy policy

The energy policy of Hungary that is currently in force was approved by Parliament in April, 1993 and the Government is required to submit a report to Parliament on the state of its implementation every two years.

The principles and strategic objectives of the energy policy approved in 1993 are in harmony with the realization of the market economy, the extent of competition, and with Hungary`s efforts of towards accession to the European Union.

Certain aspects oft he strategic concepts have already been implemented, and the organizational, economic and legal conditions conforming to the market economy have also been developed.

The basic energy policy principles of primary importance are as follows:
- creating a domestic energy market taking into account the national peculiarities, complying with the principles of the unified European energy market, ensuring the competitiveness of the economy in the interests of the energy consumers;
- enforcing the environmental protection requirements both with regard to the existing generating or consumer equipment and to their future development in order to realize sustainable development;
- intensifying the role of energy conservation, increasing the efficiency of the use of energy.

Another aim of Hungary`s1993 energy policy was to prepare for accession to the European Union and to modify the laws governing branches of the energy industry in accordance with the new trends of the European Union. The document entitled “Principles of Hungary's energy policy, commercial model of energetics” passed by Governmental Decree 2199/1999. (VII. 6.) Korm. lays special emphasis on the harmonization of the legal framework related to the European integration process in the field of energetics.

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 Paks Nuclear Power Plant Ltd. The contribution of nuclear energy to the total generation of electric energy was, 39.1% in 2001; 39.4% in 2002; 32.7% in 2003 (the reduction in 2003 was predominantly caused by the long-term outage of Unit 2 due to the serious incident mentioned in the Summary (see Annex 7 for details). These figures illustrate that nuclear energy is a vital and strategic issue not only for the electric energy supply of the country but also for the country as a whole, and this is expected to remain so in the coming years.

The significance of nuclear safety

Act CXVI. of 1996 on atomic energy (hereafter 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.

Since the late 1970's, in relation to the installation of Paks NPP, the Hungarian Authority has always recognized the significance of safety and has required the submission of safety reports for the licensing of the installation, and has always prescribed the application of a quality assurance system.

In addition to enforcing conditions stipulated in legal regulations the Hungarian Atomic Energy Authority (hereafter the Authority) also considers it one of its duties to ensure the practical implementation of the spirit of the law in everyday work. In accordance with the internal procedural order of the Authority, nuclear safety inspectors are obliged to take decisions in a conservative manner biased towards safety should any not clearly assessable situation arise.

Hungary introduced a decree in 1993 stipulating the performance of periodic safety reviews and the submission of safety reports containing the results of such assessments. The first periodic safety review of Paks NPP was completed for Units 1 and 2 by the end of 1996 and for Units 3 and 4 by the end of 1999. On the basis of the safety reports submitted by Paks NPP the Authority extended the validity of the long-term operation license and, at the same time, prescribed further safety upgrading measures.

International reviews

Since commencing operation, Paks NPP has paid special attention to utilizing international experience and, at the initiative of the power plant, 30 international reviews have taken place since 1984. These include all kinds of important reviews organized by the International Atomic Energy Agency and that have been performed at the nuclear power plant.

The activities of the Authority have been surveyed by projects performed by the RAM Group (Regulatory Assistant Management Group) delegated by the European Union and by the IAEA IRRT (International Regulatory Review Team) mission. Although they expressed their basic satisfaction with the results, the groups did formulate several suggestions. The new regulatory system introduced in the late 1990s took into consideration the suggestions of the first RAM project. The suggestions of the second RAM project and the IRRT mission have played significant role in the development of new working methods in the Authority.

International relations

In Hungary both the Licensee and the Authority maintain wide- ranging relations with various international and national nuclear organizations, professional bodies, institutes, nuclear power plants abroad, companies involved in the design, manufacture 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 on several committees, with many of them being board members of international organizations or invited as experts.

International bodies of major importance are: the International Atomic Energy Agency (IAEA), the OECD Nuclear Energy Agency (NEA), the World Association of Nuclear Power Plant Operators (WANO), the WWER-440 operators' club, the WWER users' group, the International Nuclear Safety Program (the so-called Lisbon Initiative), the Nuclear Maintenance Experience Exchange (NUMEX) 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.

The Authority has established technical co-operation with authorities of WWER operating countries via the WWER Regulators’ Forum. The Authority has signed mutual information exchange agreements with the relevant organizations of Canada, France, Romania, Russia, the United Kingdom, and the United States of America. The Authority has benefited from the technical co-operation programmes of the International Atomic Energy Agency (IAEA) and from several projects of the European Union's PHARE programme. Hungary has been a member of the OECD since 1996; there are Hungarian representatives in eight committees of the Nuclear Energy Agency. The Authority takes an active part in the work of the "CONCERT" group, the Network of Regulators of Countries with Small Nuclear Programs (NERS) and in the group operated by the European Commission Nuclear Regulatory Working Group (NRWG).

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.

1. EXISTING NUCLEAR INSTALLATIONS

1.1 Paks Nuclear Power Plant

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

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

1.1.1 Main technical attributes

The main technical data of the units of the Paks NPP are summarized in Table 1.1.1-1.

Table 1.1.1-1 Main technical attributes of a unit of the Paks NPP

Reactor type	Pressurized-water, water-cooled, water-moderated power reactor, type: V-213
Thermal power of the reactor	1375 MW
Electric power output of a unit	460 MW (2 turbines/unit): 2∗230 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	282 ± 2 °C
Height/diameter of the pressure vessel	11.8 m/ 4.27 m
Enrichment of the fuel	2.4-3.82%,
Fuel quantity per unit	42 tons U in 349 fuel assemblies
Number of turbines per unit	2
Pressure in the secondary circuit	46 bar

Paks Nuclear Power Plant Ltd operates four pressurized-water units of type WWER-440/V-213; both the moderator of the reactors and the coolant 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 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 dealing with 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 airtight rooms and localizing towers makes up the pressure suppression containment for the reactors.

Each unit is installed with three active safety systems, and in case of abnormal events their electrical supply is ensured by diesel generators. These systems are supplemented by passive systems. Two saturated (wet) steam turbines operate in each unit. The rated thermal power of each unit is 1375 MW, and the rated electric power outputs of the four units are 467 MW_e, 468 MW_e, 460 MW_e and 471 MW_e, respectively.

The designers of the power plant chose the twin-unit version previously used successfully in the Soviet Union. This implementation has numerous technological advantages. The turbine hall 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 single exception being the safety cooling water system - where the pressure leg from the pumps to the pressure-equalizing tank is shared by two units.

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

1.1.2 Safety reviews

National and international reviews have always been important and promoting elements of the constant endeavours aimed at assessing and increasing the safety of the nuclear power plant.

A list of international safety reviews performed at Paks NPP is contained in Table 4.3.8-1. In addition, the AGNES (Advanced and General New Evaluation of Safety) project was of great significance in performing the safety assessment of the nuclear power plant as a means of determining its conformance with the accepted international standards of the 1990's. Detailed information about the project can be found in the first National Report (1998). The periodic safety review of Units 1 and 2 was completed in 1996 and for Units 3 and 4 in 1999.

The conclusions arising from the reviews were on the whole positive. However, they all highlighted several problems which were dealt with in the following years by scheduled improvement measures.

Within the scope of the safety improvement measures numerous projects have already been implemented while the accomplishment of some long-term projects requiring significant resources is expected in the coming years. The safety upgrading modifications and developments are described in the Sections 3.7.5 and 3.7.6.

On the basis of the results of the assessments described here and in detail in Chapter 4.3 it can be stated that Hungary has fulfilled all those requirements stipulated in Article 6 of the Convention.

1.2 Spent Fuel Interim Storage Facility

Since the possibility to return spent fuel assemblies from Paks NPP to the Soviet Union and later to Russia has become increasingly uncertain, the construction of an interim storage facility on the site of the nuclear power plant became necessary. The nuclear power plant commissioned the British company GEC Alsthom to build a dry storage facility of the MVDS type. One of the advantages of this type of technology is that the number of storage vaults can be increased in a modular system. The positioning of modules in a row allows the use of a common reception building and loading equipment. Each module is capable of housing 450 fuel assemblies.

Spent fuel assemblies are held individually in vertical tubes in the storage building. In order to prevent corrosion processes during long-term storage, the storage tubes are filled with nitrogen gas and are placed in vaults surrounded by concrete walls. The removal of the residual heat generated by the irradiated fuel is obtained by the 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 sealed environment.

It is intended to store the spent fuel assemblies removed from the reactors for a period of 50 years.

The capacity of the first phase of the Interim Storage of Irradiated Fuel ensures the storage of (11 chambers) 4,950 fuel assemblies. This amount equals the number of spent assemblies generated during 10 years of operation of all four units. The capacity of the facility can be increased for the interim storage of all irradiated fuel generated during 30 years of operation. Currently the preparation for establishing the next five chambers is under way.

The first phase has been completed; currently the loading of the 8th chamber is proceeding. By the end of 2003, a total of 3497 fuel assemblies had been loaded into the storage facility. The holder of the operating license of the Interim Spent Fuel Storage Facility is the Public Agency for Radioactive Waste Management.

1.3 The Budapest Research Reactor and the Training Reactor of the Budapest University of Technology and Economics

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

The Budapest Research Reactor operated by KFKI Atomic Energy Research Institute was built in 1959 and its full reconstruction was carried out between 1986 and 1993. In 2003 the decennially due nuclear safety review of the Budapest Research Reactor was completed. Based on the results of the review the Authority, apart from prescribing the measures for improvement with deadlines expiring in 2004-2006, issued the license for the further operation and for performing the activities described in the Final Safety Analysis Report. The operating license is valid until revocation.
Main technical data of the reactor:

- tank-type reactor, the material of the tank is an aluminium alloy;
- coolant and moderator: light water;
- fuel: VVR-SM, 36% enrichment;
- rated thermal power: 10 MW.

The reactor operated by the Institute of Nuclear Techniques at the Budapest University of Technology and Economics was built in 1972 for training and research purposes. Based on a Periodic Safety Review performed by the Authority in 1996, the license was renewed for a further 12 years.

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

2. LEGISLATION AND REGULATIONS

2.1 The Act on Atomic Energy

The Hungarian Parliament approved the current Act on Atomic Energy in December 1996 (Act on Atomic Energy) which entered into force on 1 July 1997. The Act on Atomic Energy considers all legislative, authority-related and operational experience gained during the construction and operation of Paks NPP, considers the technological development achieved since the issue of the previous Act on Atomic Energy, our international obligations, and obviously integrates the requirements of the Convention as well. The main criterion and key point of this is Subsection (2) of § 24 which states: "In the use of atomic energy, safety has priority over all other aspects.".

Thus the Act on Atomic Energy provides the basis for fulfilling the requirements stipulated by Article 10 of the Convention.

For the development of the Act on Atomic Energy the recommendations of the European Union, the International Atomic Energy Agency as well as the OECD Nuclear Energy Agency were considered.

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 following are the main characteristics of the Act on Atomic Energy:

- declaring the priority of nuclear safety;
- defining and allocating the 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;
- declaring the organizational and financial independence of the Authority;
- declaring the need for utilizing human resources, education and training, and research and development;
- defining 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 broken.

Parliament modified the Act on Atomic Energy in 2003, and in accordance with the expectations of the European Union it reinforced the independence of the Hungarian Atomic Energy Authority with the following main changes:

- from 1 August 2003 it abolished the Hungarian Atomic Energy Commission (HAEC) established in 1955, sharing the tasks of the chair of the HAEC between the Director General of the HAEA and the minister supervising the HAEA;
- it established the Atomic Energy Co-ordination Council. This Council is a board established by the government in the field of peaceful application of nuclear energy. The Council, based on the Act on Atomic Energy, harmonizes the activities of the ministries and central

administration bodies fulfilling regulatory tasks in the field of safe application of nuclear energy, nuclear safety, and radiation protection. Within its scope of tasks described in section (3) Article 6 of the Act on Atomic Energy, the Council fulfils a coordinating activity in the framework of which it makes proposals, issues statements, and initiates the preparation of analyses.

The supervision of the HAEA, dating from 1 August 2003 was handed over by the Minister of Economy and Transport to the Minister of Interior.

2.1.1 Implementation of the Act on Atomic Energy

Several government decrees and ministerial regulations have been issued to implement the requirements of the Act on Atomic Energy and further regulations are expected to be issued. During the period 2001-2003 the following laws were promulgated:

- governmental decrees:
  - *275/2002. (XII. 21.) Korm.* on the monitoring of the national radiological situation and radioactive material concentration;
  - 32*/2002. (III. 1.) Korm.* on the licensing of the transboundary shipment of radioactive wastes as the implementation of the act (*LXXVI. of 2001*) promulgating the joint international convention established concerning the safety of spent fuel management and the safety of radioactive waste management;
  - *114/2003. (VII. 29.) Korm.* on the scope of duty, authority and jurisdiction of imposing penalties by the Hungarian Atomic Energy Authority, and on the activities of the Atomic Energy Co-ordination Council. The decree, in accordance with the stipulations of the Act on Atomic Energy, re-regulated the duties and authority of the Hungarian Atomic Energy Authority;
  - *165/2003. (X. 18.) Korm.* on the order of public information in the case of a nuclear or radiological emergency. The decree was issued in accordance with the prescriptions of the European Union.
- ministerial decrees:
  - *8/2002. (III. 12.) EüM* decree of the Minister of Health on the regulation of the structure and operation of the radiological monitoring and data service network of the health section;
  - *33/2002. (V. 3.) HM* decree of the Minister of Defense on the defense application of the Act on Atomic Energy;
  - *47/2003. (VIII. 8.) ESZCSM* decree of the Minister of Health, Social and Family Affairs on certain issues of interim storage and final disposal of radioactive wastes, and on certain radiohygiene issues of naturally existing radioactive materials concentrating during industrial activity.

Details about the Hungarian Atomic Energy Authority are contained in Chapter 2.2.

Most of the official issues related to the safety of nuclear installations, in particular with respect to the nuclear power plant, are regulated by Govt. Decree 108/1997. (VI. 25.) Korm. The following standards were issued as schedules to this decree:

1. Licensing procedures applied to nuclear power plants
2. The quality assurance standard of nuclear power plants
3. General requirements for the design of nuclear power plants
4. Operational safety requirements of nuclear power plants
5. The nuclear safety standard of research reactors

This decree entitles the Director General of the Authority to issue guidelines concerning the actual implementation of the requirements. By the end of 2003, 61 guidelines had been issued. Within the framework of the implementation of the regulating tasks, the modernization of the regulatory requirement system related to nuclear safety continued by taking into account the newest scientific results, and domestic and international experience.

Further detailed regulation of the tasks related to the implementation of legal requirements is ensured by the internal procedures elaborated by the Authority and by the internal system of regulations and instructions prepared and operated by the Licensee.

2.2 The Authority

In the case of nuclear installations as defined by Article 2 of the Convention, the relevant authority in Hungary is the Hungarian Atomic Energy Authority, based on Subsection (4) of § 8 of the Act on Atomic Energy; its official tasks related to the Convention are contained in points a) to l) of Subsection (2) of § 17.

The Hungarian Atomic Energy Authority (the Authority) is an administrative body operating in the field of peaceful use of nuclear energy, under the supervision of the Government. Until 1 August 2003 it was supervised o by the Minister of Economy and Transport, since that time, based on the decision (81/2003. (VII. 29) ME) of the prime-minister, this task has been fulfilled by the Minister of Interior.

The Authority's scope of competence comprises nuclear safety licensing (at the levels of the facility, systems and components) and supervision of nuclear installations, the registration and supervision of radioactive substances, the licensing of the transportation and packaging thereof, the licensing of nuclear exports and imports, the evaluation and co-ordination of research and development, the performance of authority-specific tasks related to nuclear emergency preparedness, the approval of the emergency response plans of the nuclear installations, and the maintenance of international relations. Those topics related to the application of nuclear energy during the discussions concerning the accession of Hungary to the European Union also fell within the terms of reference of the HAEA. The Hungarian Atomic Energy Authority co-ordinated all issues relating to nuclear energy and radiation protection in the chapters "Energy" and "Environmental Protection".

It is the duty of the Authority to perform the tasks generated by the treaty concluded with the International Atomic Energy Agency dealing with the non-proliferation of nuclear weapons, along with the registration and supervision of nuclear substances.

With regard to the financial independence of the Authority under the Act on Atomic Energy, this is mentioned under Section 3.3.1 of this Report.

The Authority's human resources are described under Section 3.4.1 of this Report.

On two occasions the activities of the Authority were surveyed by IRRT (International Regulatory Review Team) missions of the International Atomic Energy Authority. The second of these two missions, the follow-up mission, was conducted by the experts of the IAEA from 9-13 February 2003. On evaluating the situation and the work accomplished, the IRRT team concluded that the HAEA Nuclear Safety Directorate had made efforts, with regard to each previous recommendation and suggestion, to improve its performance and that a significant step forward had been made in most areas. Among these were: the development of a legal framework that better serves safety, enhancement of the independence of the regulator, continuation of the elaboration of the regulations and guidelines, the introduction of a training programme specially tailored for inspectors, implementation of comprehensive and team inspections by the licensees, elaboration of the enforcement policy of the regulator, the introduction of an internal quality management system and its certification against the ISO 9001:2000 standard, extension of the scope of emergency tasks and response capabilities, including the improved coordination with the other participating authorities. For quantification purposes, the follow-up mission can be summarized in the following way: after the recommendations and suggestions of the first mission, a further two recommendations and four suggestions were formulated by the international expert team, and besides them it recognized five new “good practice” approaches that are worth mentioning.

In accordance with Hungary's two-tier administrative system, a unit of the Authority (the Nuclear Safety Directorate) acts as an authority of the first instance in nuclear safety issues, in the second instance the Director General of the Authority proceeds. The departments of the Nuclear Safety Directorate are as follows:

- the Department of Licensing;
- the Department of Inspection;
- the Department of Technical Support - responsible for analysis, training and emergency preparedness;
- the Independent Section of Strategic Affairs - responsible for enforcement, for the review and maintenance of the laws, regulations and guidelines, and for contacts with the various co-operating authorities.

These departments operate under the direct control of the Deputy Director General heading the Nuclear Safety Directorate of the Authority.

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

The principal tasks of the General Nuclear Directorate are:

- to perform the tasks imposed on Hungary by the Safety Convention concerning the non-proliferation of nuclear weapons (Department of Nuclear and Radioactive Materials);
- to survey the legal situation relating to the accession of Hungary to the EU, to co-ordinate duties in connection with the 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).

The Section of Legal Affairs, the Section of Informatics, and the Department of Economy as well as the management of quality control operate under the direct control of the Director General.

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 order to support its activities, the Authority has concluded separate agreements with several scientific institutions. Such an agreement seals the co-operation with the KFKI Atomic Energy Research Institute, the Institute of Nuclear Techniques at the Budapest University of Technology and Economics, the Department of Radiochemistry of Veszprém University, the Electrical Power Research Institute Ltd (VEIKI), and the Institute of Isotopes.

The support organizations carry out expert and scientific activities not only for the Authority but for the nuclear institutions 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 theme exclusively for the operator or the Authority but not for both simultaneously. The relatively comprehensive system of censure, the internal quality assurance system of the support organizations and the careful selection of the reviewers guarantee the appropriate offending of interest and independent decision-making of the Authority.

Foreign institutions and experts have also been co-opted to participate in particular studies.

In addition to those entities already listed, and in accordance with Subsection (7) of Article 8 of the Act on Atomic Energy, the work of the Authority is supported by a Scientific Council made up of nationally recognized individuals.

On the basis of the above it is stated that the Authority holds all the necessary resources to establish a safety culture of an appropriate standard and it meets the requirements stipulated under Article 8 of the Convention.

The Ministry of Health undertakes the tasks of the authority regarding issues related to radiation protection and concerning the facility-level licensing and supervision of the storage of radioactive wastes. Other competent administrative bodies take part as special authorities in the licensing procedure of the Ministry of Health.

2.2.1 Licensing procedure

The basic principles of the licensing procedure of the nuclear power plant facility and the sphere of authorities taking part in the licensing procedure are regulated by Chapter III. of the Act on Atomic Energy.

To establish a new nuclear power plant or a new nuclear power plant unit the preliminary consent in principle of Parliament is required when starting preparatory work; to establish ownership of a nuclear power plant that is in operation or transfer the right of operation through a legal construction the preliminary consent in principle of the Government Parliament is required.

In concordance with the regulations in force, a license shall be obtained from the authorities for all phases of operation (siting, 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 procedures, the technical aspects are enforced by the legally delegated authorities. The Authority shall take into consideration the opinions of the legally delegated special authorities.

At the installation of a new nuclear power plant, the precondition for launching the licensing procedure is the existence of an environmental protection license. During the licensing procedure the Licensee prepares a preliminary environmental impact study. The environmental protection authority then sends the preliminary impact study to the relevant authorities to seek the jurisdiction of the authorities of the potentially affected areas, who – in turn - expose it to public view.

The environmental protection authority, if it does not reject the detailed environmental impact study that has been submitted, shall subsequently hold a public hearing. Based on the detailed 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 plant.

If the potential for transboundary environmental impacts exists, in accordance with the Espoo Convention, Hungary informs the partner states by sending them the preliminary impact study; their opinion is taken into account by the Hungarian environmental protection authority during its licensing procedure conducted by basing it on the detailed environmental impact assessment.

The safety-informed licensing of a nuclear installation takes place after the environmental protection licensing. The public and the civil organizations do not participate in that process. The environmental protection authority plays the role of special authority in the course of licensing a nuclear installation.

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

Those licences to be issued based on Act CX. of 2001 on Electric Energy are also required for establishing and operating a nuclear plant.

Licenses are valid for fixed periods; on request and given that the necessary requirements are fulfilled, they may be extended. A Licensee can appeal against the decisions of the Authority; if an appeals is made against a regulatory decision it is re-judged by the authority of second instance. Appeals against the decision of the authority of the second instance may claim the right to take the case to court.

The Licensee of Paks Nuclear Power Plant is the entity known as Paks Nuclear Power Plant Ltd.

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. Any decision on the further validity and conditions of the operating license is included within the framework of the review.

2.2.2 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 inspection 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 previous notice, should it be justified. Such inspections may be performed periodically 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, inspecting any documentation or checking a report prepared by the Licensee, or any combination of these. The Authority prepares a programme for comprehensive and periodic inspections, and notifies those involved in due time. Inspections or the assessment 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 specialist authorities taking part in the licensing procedure also perform separate official 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 taking of measures in order to prevent their repeated occurrence is primarily the task of the nuclear power plant.

Any event affecting nuclear safety is required to be reported immediately 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 inspection carried out by the Licensee, the Authority analyses and evaluates the event and initiates further measures if necessary.

As a means of extending the inspection tools (and also taking into account domestic methodological experience), the Authority together with Paks NPP itself introduced the system of safety indicators. The term “safety indicators" means the sum of measurable parameters, which, among others, measures the performance of the organization and that of the human factor. The safety indicators cover many fields, such as the number and effects of shutdowns and power drops due to internal events during operation, activation of the protection systems fulfilling basic safety functions, the state of equipment, evolution of working accidents, human commitment, and the need to keep the deadlines. The accumulated statistical set of indicators, within the brief time-scale of 1-2 years, has provided the possibility both for comprehensive evaluation and as a means of highlighting various issues.

2.2.3 Enforcement of the legal mandates of the Authority

The conditions for enforcing the legal mandates of the authorities are contained in Act IV. of 1957 regarding the general rules of administrative procedure, in Act IV. of 1978 concerning the Penal Code, and in Govt. Decree 114/2003. (VII. 29.) Korm.

Should there be any deviation from the regulations in force, the Authority may initiate an administrative procedure 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 official 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 specialized authority involved in the licensing procedure, the Authority, at the request of the specialist 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 NPP as an establishment, but also against individuals employed in the area of the application of nuclear energy.

Those principles and objectives formulated during the periodic revisions of the Safety Guidelines required by law every five years serve to strengthen the power of the Authority. The goal of the periodic review of the Nuclear Safety Regulations determined by law is that of taking into account the scientific results and international experience since these help to ensure the appropriate regulation background for the upcoming period.

The revision of the Safety Regulations conducted during 2002-2003 extended or specified the requirement system in certain fields including the requirements for pressure piping and pressure vessels, building structures, programmable tools, chemical planning, and water supply. During the revision emphasis tended to be placed on the deterministic safety analyses; however, the risk-informed approach remained conservative. The number of probabilistic goal values and parameters have not grown, neither have their values changed.

The coming into force of the revised regulations was impeded by the serious incident at Paks NPP in April, 2003. It became obvious after the incident that according to the 1977 regulations - after evaluating the activity of the plant, the role of the designer in the incident, and that of the Authority - the already completed drafts of the new regulations need to be reviewed again. In particular, the drafts should be evaluated to determine whether the weighting of the technical problems according to their safety significance, the assigned safety classification and the related procedures deriving from them ensure the avoidance of the occurrence of similar design-, technical preparatory-, or licensing errors.

Subsequent to their mission in June, 2003, the International Atomic Energy Agency's IRRT made recommendations for revising the regulations; these recommendations were considered in the course of the repeated revision.

Revision of the guidelines as a means of helping to fulfill the requirements of the regulations has become an ongoing process. The termination of the review of the Nuclear Safety Regulations will entail reviewing a set of guidelines. The correction and specification of the regulations and the involvement of such fields that have so far remained outside the scope of the guidelines will improve the enforceability of the regulations.

Discharging of legal authority will be facilitated by the enforcement policy formulated in 2000 as the legal aspect of the Safety Policy issued in 1996. The enforcement policy summarizes the objectives and necessity along with the legal resources. The first enforcement policy of the HAEA was approved by the HAEA `s Director General at the end of July, 2001.

Enforcement takes place along with the regulatory procedure. Even though the procedure is an internal document of the Authority, it was also presented to the Licensee primarily because of the enforcement examples involved.

The principal objective of the enforcement policy is to forestall the infringement of existing rules; to facilitate the early, voluntary revealing of discrepancies; and to support their reporting and correction - even if this means imposing sanctions.

In connection with the infringement of the prescriptions preceding and during the incident of 10 April 2003, the inspectors of the HAEA NSD initiated three enforcement procedures. Up till now, the administrative part of one of them has been completed.

The full text of the enforcement policy of the HAEA - both in Hungarian and English - can be found on the HAEA`s website.

2.2.4 Communication policy of the 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 regulatory activity. It 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 most important form of information activity is the annual report to be submitted to the Government and Parliament, whose preparation is the task of the HAEA. This Annual Report is compiled by the HAEA.

Press releases related to the occurrence of incidents are published by the operators; the Authority's participation is only in relation to the INES (International Nuclear Event Scale) classification of events.

An Internet-based service is integrated into the communication policy of the Authority. Regulations concerning the users of nuclear energy, the R&D results related to the activities of Authority, reports about emergency preparedness, reports of international revisions and missions, along with topical information and news are published on the Internet. One can find the National Report on the Authority's home page, both in Hungarian and in English.

2.3 Responsibilities of the Licensee

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 the technical, technological, financial and personal conditions for a facility's safe operation;
- to prevent the occurrence of an unintentional and uncontrolled nuclear chain reaction;
- to prevent the evolution of any unacceptable damage affecting employees, the local population, the environment or material assets, caused by ionizing radiation or any other factor;
- to maintain the radiation exposure of the employees and the 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 constantly carry out activities to improve safety, and to finance the costs of related research and development activities;
- to regularly revise and upgrade its own regulatory system serving to fulfill the safety related requirements;
- to take into account the limits of human performance from the aspect of safety;
- to fulfill the obligations of the Republic of Hungary arising from the international contracts in the field of peaceful uses of atomic energy;
- to ensure that the qualifications, professional training and health of the employees are in line with the prescribed requirements;

- to hire only those subcontractors and suppliers that have an appropriate quality assurance system;
- to ensure the financial coverage of indemnity (insurance);
- to appropriately handle extraordinary events;
- to indemnify within a limited time and under a certain amount for the damages caused due to the application of atomic energy;
- to ensure the safeguarding of the establishment by armed guards, and to prevent unauthorized persons from access to nuclear materials and equipment;
- to make regular payments into the Central Nuclear Financial Fund to cover the 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.

Of the prescriptions listed under this Chapter it can be stated that the Republic of Hungary fulfills all stipulations in Article 9 of the Convention concerning the responsibilities of the Licensee.

3. GENERAL SAFETY ISSUES

3.1 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 Hungarian 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 was supplemented in 2001 by the document entitled Enforcement Policy. In the spirit of these documents several assessments were performed by the Authority to survey the operator's safety culture. The Authority extensively assessed its own operation in the second half of 2003, during which it considered the recommendations and remarks of the IRRT mission of the International Atomic Energy Agency conducted in June, 2003. Completion of the review is due in the first half of 2004, by the evaluation of the resources. The IRRT mission of the International Atomic Energy Agency in 2000 and its follow-up mission in 2003, and the RAM projects of the Western-European authorities also contribute to the self-assessment of the Authority. The next project will begin in the first half of 2004, on regulation, on equipment qualification, on emergency preparedness, and in law enforcement fields.

3.1.1 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 the nuclear installation. Another of the Authority's objectives is to oblige the Licensee to completely fulfill the tasks related to its responsibility to maintain the full-scale safety of the nuclear installation throughout its whole lifetime. The Authority exercises its inspection activities in order to achieve these objectives; these inspection activities comprise licensing, inspection, supervision, analysis, evaluation, and the enforcement of regulations.

It is also an objective 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.

3.1.2 Responsibility

The Authority is responsible for the licensing and inspection of nuclear installations, systems and components along with the enforcement of 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 associated authorities and to society as a whole. Every possible effort must be made to gain and retain the confidence of the population and it shall make itself and its objectives fully transparent to the public. The HAEA meets all the above requirements.

In addition, the Authority has the responsibility of ensuring the emergency preparedness activities described in Chapter 3.9 of this Report. It is prepared to act as an independent assessor and advisor in such a process by making diagnoses and prognoses at an early phase of a potential nuclear accident. It is the Authority's task to approve the Emergency Response Plan of the licensees and to supervise their emergency preparedness.

3.1.3 Basic principles of the operation of the Authority

The functioning of the Authority is regulated by the Government, in accordance with the Act on Atomic Energy. The regulations governing the work and the 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 down to an appropriate level. In the field of safety improvement measures, however, the Authority should also set a priority list. Priorities should be examined not only from the viewpoint of the reduction of risk but also taking costs into account.

Technical problems and human errors can be defined as initiators of accidents, thus the primary task is to minimize their frequency. The secondary task is to mitigate any serious consequences originating from multiple failures, for the accomplishment of which 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 for assessing safety and when identifying weak points.

The Authority follows the above principles in its work.

3.1.4 Practical side of the Authority's work

The Authority 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.

The Authority, when performing administrative tasks, takes into account as far as possible the viewpoints of the Licensee.

The Authority endeavours to weigh every issue according to its importance. Importance is determined in relation to safety. Such weighting may not be a reason for breaching regulations prescribed by law, nor for criticizing or neglecting the tasks prescribed by law.

It assesses the severity of off-normal events that may occur by processing them in an increasingly precise manner and utilizes the feed-back of experience gained in the operation process.

The practical side of the regulatory work, besides keeping to the original principles and modifying some of the emphases, was re-formulated at the end of 2003 in the reviewed safety policy.

High standards of work shall be ensured through the operation and continuous maintenance of an internal quality assurance system. The Authority's quality management system is described in Section 3.6.3.

3.2 Safety policy of the Licensee

Govt. Decree 108/1997. (VI. 25.) Korm. concerning the implementation of the Act on Atomic Energy consistently applies the principle of the priority of safety by obliging the Licensee to have prepared a safety policy by the time the application for a commissioning license is submitted. The purpose of this document is to list the concepts and objectives of the Licensee related to safety and demonstrate that it reflects in a convincing manner the fulfilment of the principle of nuclear safety having priority over all other aspects.

The same decree obliges the Licensee to implement the safety policy that has been submitted and approve, and to check the fulfilment of all safety requirements. It also obliges the Licensee to establish its own internal supervisory body, such a body that is independent of operation control.

The Safety Policy (as a document) was created in order to summarize the main safety-related activities of 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.

In order to maintain and enhance safety, the Safety Policy of Paks NPP 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. It determines the responsibilities and formulates expectations for each employee. The Safety Policy emphasizes the importance of the commitment to safety, its positive approaches to safety, the need to reveal those factors compromising safety, and its endeavours to improve the safety culture. It stresses the importance of training, information and feedback for enhancing safety.

According to the Safety Policy, a suitable programme should be at hand to control and supervise the operation and other activities. Data acquisition and processing should be performed in order to evaluate safety. The appropriate analysis and utilization of internal and external experience are extremely important.

3.2.1 Responsibility of principal executive officers

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

The executives are responsible, within the framework of their areas of competence, for the fulfilment and enforcement of safety requirements in addition to the enforcement of the Safety Policy.

In order to define the various tasks, responsibilities and competence together with legal responsibilities, the NPP`s Director General set up the regulatory hierarchy defined in the Quality Assurance Manual. Job descriptions also lay down rights and areas of competence.

3.2.2 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 or before the 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 Education Manual. 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 prescribed 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 ongoing 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 Training Center of the nuclear power plant contributes to the preparedness of the maintenance staff (detailed information on the Maintenance Training Center can be found in Section 3.4.2).

It is the task of the 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:

- elaboration 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 prescribed 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.

3.2.3 Responsibility and safety related issues concerning the employment of outside contractors

On the premises of the nuclear power plant, work maybe performed only by outside contractors holding a valid qualification approved by 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 Regulations and the procedural order approved by the Authority, under regular inspection by the Authority. Paks Nuclear Power Plant Ltd is responsible as auditor for the carrying out of the auditing and evaluating procedure and for the fulfilment of the conditions for qualifying.

The fulfilment of the requirements of the Quality Assurance Manual - and those of the more detailed internal regulations - is mandatory for all outside organizations and contractors performing work on the site of the nuclear power plant. The hiring organization inspects all work performed by an outside contractor 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.

On the basis of Chapters 3.1 and 3.2 it can be stated that the key principle of safety (concordant to Article 10 of the Convention) is properly followed in Hungary by both the Authority and the Licensee.

3.3 Financial resources

3.3.1 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 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 an inspection 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 the nuclear installations and its funding is sufficient for it to carry out its duties efficiently.

3.3.2 Financial resources of the Licensee

Act CX. of 2001 on Electric Energy stipulates that producers are permitted to sell on the free market. Any electric energy remaining above the amount contracted for public purposes. However Paks NPP Ltd, in accordance with the requirements of governmental decision 2280/2001 and with the intent of the owner, currently sells the electric energy produced only under public purpose conditions.

The Act on Atomic Energy prescribed that a fund, the Central Nuclear Financial Fund, be created for financing the interim storage and final disposal of radioactive waste and spent fuel elements and the decommissioning of nuclear installations. In order to fulfil these requirements an independent organization, the Public Agency 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 Agency for Radioactive Waste Management on the basis of planned investment and operational costs along with international data. These payments are approved by Parliament as part of the act dealing with the annual budget agreed upon with the Hungarian Energy Office and with the Hungarian Atomic Energy Authority. These payments, based on the Section 4 of Article 63 of the Act on Atomic Energy, shall be considered when determining the price of electric energy.

3.4 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.

3.4.1 Human resources of the Authority

The Authority employs a total of some 90 individuals of whom about. 85% are experts holding a higher education degree (university or college), nearly 50% have two or three degrees (the second degree usually being obtained in disciplines dealing with nuclear techniques). About 20% have PhD an advanced academic or higher degree.

Those employed by the Authority may perform official activities on their own (licensing and inspection) only if they pass a nuclear safety or nuclear material inspector's examination (to be repeated every 3 years).

To acquaint the staff of the Authority with the practice 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 education plan 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 emergency preparedness training programme is an independent and continuous part of the education plan.

The Authority's representatives take part in international technical public life. They are active members of the working groups of the International Atomic Energy Agency, the European Union, and the OECD Nuclear Energy Agency.

3.4.2 Human resources of the Licensee

As of 31 December 2003, the number of individuals employed by Paks Nuclear Power Plant Ltd was 2,781; of these, 90 are heads of divisions or higher level executives. The number of those engaged in operations is 1,139; the number of maintenance staff is 820, and the number of others ensuring support activities is 819. The composition of employees in relation to qualifications is as follows: 811 with a higher education degree, 1,451 with a secondary school qualification, and 516 skilled workers or people with other types of qualification. Of the operating personnel, 361 have a valid official license for performing 25 different types of function.

A continuously updated job description comprising the basis of a unified system and qualification requirements are laid down for all jobs. The management of the power plant laid down the expected and appropriate rules of behaviour for its employees in a Code of Ethics.

Within the power plant, the system of expert training is well regulated; the material and personal conditions are also assured by the power plant. The expert training system is job oriented and consists of a series of modules ordered in hierarchic structure. Theoretical training is always followed by practical training. Both theoretical and practical training are concluded by exams the passing of which entitles the individual to be employed in a particular position. However, training does not come to an end on obtaining the qualification: Training courses and check-ups aimed at increasing knowledge continue together with periodic adequacy tests every three years. Annual medical and psychological fitness tests are also a prerequisite.

For posts of greater responsibility and vital to safety, training courses conclude with an official licensing examination. The method and content of the examination are contained in the given licensing procedures and instructions.

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

Paks Nuclear Power Plant Ltd trains its experts at its own cost and in its own training centers. Comparison of the system and infrastructure of training in the nuclear power plant with domestic and international experience clearly indicates that the training infrastructure is suitably developed, and the facilities of the training centers 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 Center 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 the training of operators, the simulator plays an important role in technological development projects. The most remarkable one of these is the reactor protection refurbishment project in which the simulator was used for development, testing, and validation.

The Maintenance Training Center (referred to earlier), was established with the support of the International Atomic Energy Agency. This Centre is unique in the world with its real primary components and mechanical equipment for training workshops. A special feature is that training and education make use of full-scale primary components (reactor vessel, steam generator, main circulating pump, etc.) under inactive conditions.

On the basis of Chapters 3.3 and 3.4 it can be stated that the financial and human resources necessary for the safe operation of nuclear installations are available in Hungary, thus all requirements stipulated in Article 11 of the Convention are met.

3.5 The human factor

3.5.1 Consideration of the human factor

Conclusions drawn from analysing nuclear accidents which have occurred world-wide to date justify that it is necessary to approach and handle the human factor as a key element, and the level of preparedness of personnel should be continuously increased. When evaluating the results of the annually accomplished probabilistic safety analysis, it was clearly shown that the careful work of the personnel plays a significant role in avoiding core damage.

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 the 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.

3.5.2 Manpower selection

The strategy for human resources of Paks NPP Ltd is to ensure that they have a team of adequately prepared employees who are qualified according to the requirements of their given job and appropriately selected to perform long term, safe, economic, and reliable operation and maintenance.

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 prescribed for the given job and in addition meet the appropriate medical and psychological requirements. The corresponding manager and the employee himself or herself are jointly responsible for the fulfilment of all these requirements. Admittance to different areas of the nuclear power plant is permitted only on fulfilment of the above-mentioned conditions. From the point of view of safety the whole area of the power plant is divided into zones.

Training and examinations are conducted in the power plant and in a unified and identical way for both the NPP staff and hired outside employees.

Once a year every employee is required to have a medical check up. The fulfilment of psychological criteria is also checked annually in jobs requiring periodic examinations. Before taking the periodic examinations, one of the Authority's representatives checks whether all tests have been performed and all prerequisites have been met. Medical and psychological adequacy tests are subject to particularly strict constraints in the case of personnel engaged in operation, control, and supervision.

3.5.3 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 National Labour Code. As this means a particularly strict limitation of overtime work, the Human Resources Department keeps comprehensive records of the workload of employees.

The fact that within a given shift the proportion of those holding higher qualifications is constantly increasing is also a trend that tends to reduce work loads.

In order to ensure undisturbed work, the NPP established and operates a social system the scope of which in several areas reaches far beyond the services usually available, and this social system's quality and standard are much higher than anywhere else. Areas of such services are: industrial health care, psychology, transportation of employees, rehabilitation, recreation, working clothes, protective clothing, protective drinks, meals, retirement benefit insurance fund, work insurance, etc.

3.5.4 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 the four units of the NPP by 20 years beyond the design lifetime, and to obtain the necessary operating license for that. With the lifetime extension, the possibility of perspective life cycles occurs, and thus the interest of expert personnel can be preserved and the appropriate recruitment can be ensured.

Among the aspects of the human resource strategy of the NPP, performance planning and evaluation, career planning, and the opening of professional and management career possibilities play important roles. Emphasis is also placed on dealing with the employment of new specialists providing quality-based replacements and the systematic recruitment of young people.

3.5.5 Feedback of experience in order to increase safety

It is laid down in the safety policy of the nuclear power plant that the commitment to safety should manifest itself, among other ways, in the open detection of factors compromising safety and in an endeavour to enhance safety and safety culture. The objective of investigations into events is that of drawing conclusions rather than calling 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 detect 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 the definitions of the related concrete tasks and measures needed are strictly recorded.

In the case of issues related to safety culture, the forms aiming at the disclosure and review of general experience are preferred. For enhancing safety culture the NPP, involving external experts, has performed the assessment of the actual level of safety culture on three occasions. Using the results of these studies the measures leading to enhancing safety culture were able to be determined.

3.5.6 Safe working conditions

In an endeavour to reduce the possibility of erroneous human interventions, the emergency operating instructions have been put on a new basis: symptom-based instead of event-oriented. After the full-scope training and examining of the personnel, the new, instruction packages were introduced in February, 2003.

Successful management of inadvertent events is also facilitated by the constant on-duty service of the independent safety controlling organization.

Healthy working conditions (proper temperature, lighting, noise and vibration levels, clean air) 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 ensured by regular check-ups and the possibility of imposing sanctions.

It is usual practice to modify or change the external conditions, the ergonomic environment or the man-machine interface by re-construction and modification so that the likelihood of repeating errors is reduced.

All tools, measuring instruments, maintenance and all other special equipment, meet the requirements both for quality and quantity.

On the basis of the contents of Chapter 3.5 it can be stated that the capabilities and limitations of human performance have been taken into consideration at Paks Nuclear Power Plant and thus the requirements in Article 12 of the Convention are met.

3.6 Quality Assurance

3.6.1 Basic principles

Quality assurance is one of the key components for guaranteeing nuclear safety. The successful accomplishment of quality assurance affects not only safety but also the reliable and economic operation of an installation.

The basic principles of the quality assurance system are as follows:

- in order to achieve their goals, it is the duty of the management and the *executives* of the installation to ensure that all activities are accomplished according to the procedural order, in an organized and controlled manner;
- the manufacturing entities and those who carry out the given activities are responsible for quality;
- the *inspectors* of the quality assurance system check whether the processes and individual tasks are carried out according to the requirements.

In operating and developing quality assurance 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 the requirements of the Nuclear Safety Regulations and of the 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 with an advanced nuclear industry 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.

3.6.2 National quality assurance system

Subsection (2) of § 11 of Act CXVI. of 1996 prescribes that "Only those institutions, organizations, …. which possess appropriate quality assurance systems can take part in activities related to nuclear facilities, nuclear systems and equipment". Moreover the Act on Atomic Energy prescribes that in the field of the application of nuclear energy only such persons may be employed who have all necessary qualifications, and that the existence of the quality assurance system defined in § 11 shall be verified.

On the basis of these legal requirements, the principles of the quality assurance system were included in Volume 2 of the Nuclear Safety Regulations, and these requirements were composed according to Code 50-C-Q of the International Atomic Energy Agency. Volume 2 on quality assurance and the 14 associated guidelines enforce the requirements of the law and define the quality assurance expectations not only towards the operator but also towards the suppliers.

3.6.3 Quality management system of the Authority

The leading executives of the Hungarian Atomic Energy Authority decided to establish a new quality management system. This decision is a part of the Medium Term Strategic Plan of the Authority. The main objectives of the system are:

- to improve the confidence of the public in the activities of the Authority;
- to promote the capability of the Authority to achieve its strategic goals;
- to make the processes more transparent;
- to clarify the points where the procedures followed at different departments merge;
- to improve the uniform regulation and organization of the activities;
- to guarantee the possibility of continuous improvement.

The elaboration of the quality management system took place in accordance with the schedule determined by the system design; consequently, the HAEA was among the first of the bodies of the Hungarian Public Administration to introduce a quality management system. The quality management system was audited and, based on the audit, certified by the internationally recognized auditing company, SGS Hungaria Ltd. The auditor certified that the quality management system of the HAEA meets the requirements of the ISO 9001:2000 international standard.

3.6.4 Quality management system of the nuclear power plant

Control

Quality Policy is the highest level document of the quality assurance system, and it includes the commitment of the management of the nuclear power plant, defines the fundamental requirement of quality, the quality objectives, the available set of instruments, and the responsibilities.
On the basis of the quality policy, the quality assurance organization has elaborated and regularly updates the *Quality Assurance Manual* of the nuclear power plant.

Personnel training is a key element of the quality assurance system of the nuclear power plant. Organizations perform necessary training in accordance with the Education Standard.

In the nuclear power plant, all work is preceded by a comprehensive task plan determining the prerequisites of the work, the ways in which it can be accomplished, the necessary human and material resources, the relevant inspections, and the extent of the anticipated documentation.

All activities within the nuclear power plant are accomplished in a way laid down and regulated in procedural orders. The preparation, review, licensing, issuance, distribution, modification and elimination of such procedural orders are defined in a company-level instruction.

An *indicator system* is used to assess the correct functioning of the quality assurance 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.

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 the procedural orders. When performing such investigations the initiating causes and necessary measures are identified.

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 in the given professional areas themselves. A separate procedural order has been prepared for handling non-conformance, but professional procedural orders also include the methods of handling potential non-conformance.

Implementation

Design work necessary for the operation of the nuclear power plant is performed by or on behalf of the various technical support organizations. The items related to the design process are as follows:

- collection of input data;
- design process;
- internal review of design (internal expert panel);
- submission of designs for licensing.

The process of *procurement* is fully regulated (from orders to import).

The calibration of measuring instruments and measuring systems is performed by the organizations operating and using the instruments and systems, under regulated conditions and in all cases meeting the requirements of the Act on Measurements.

Operating activities are accomplished in a way prescribed in the regulations, process instructions, procedural orders, and the Technical Specifications. Operations are performed on the basis of the 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 equipment. When shift changes take place, they are performed in a documented way in all cases, with a clear indication of the status of the equipment valid at the moment of hand over. All necessary temporary modifications are performed according to the procedural order. Regulated fuel management procedures covering the entire cycle also form an important element of quality assurance of operation.

The maintenance instructions, process instructions, procedural orders and implementation ensure the proper control of the maintenance process documents.

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

Auditing

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

Organizations perform their own evaluation through *self-assessments*. These self-assessments are performed on their own, with the professional support of the quality assurance supervisory organization. The results of self-assessment are reported to the senior executives of the given organization, who determine the potential measures needed.

Audits are performed by the quality assurance supervisory organization and generally regulated by the procedural order on the basis of an annual audit plan. Positive experiences obtained from such audits are widely presented. Auditors receive special training or, when auditing certain professional areas, experts familiar with the given area assist them.

The power plant audits the adequacy of the quality assurance systems of suppliers - particularly the meeting of requirements related to qualifications and the level of regulation of the organizations.

3.6.5 Role of the Authority in checking the quality assurance system

Official inspection of the elaboration and operation of the quality assurance system is a task to be undertaken by the State as declared in both the Act on Atomic Energy and the decree concerning its implementation. Inspection includes the documentation of both the control and the implementation and inspection activities.

The Authority performs a comprehensive inspection either as a system audit or a process audit. Audits are carried out on previously designated areas and 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-planned 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:

- in connection with the control activities:
  - structure of the organization,
  - training and qualifications of staff,
  - documentation,
  - treatment of non-conformity;

- in connection with the executive activities:
  - normal operation,
  - maintenance and repair work,
  - management of nuclear fuel,
  - selection of contractors,
  - design,
  - 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 primarily expects the quality assurance organization of the Licensee to undertake improvement measures related to remarks made at an official inspection and to report these measures. If this is neglected or not performed adequately, the Authority in a special resolution will itself prescribe the improvement measures.

On the basis of Chapter 3.6 it can be stated that the requirements related to quality assurance stipulated in Article 13 of the Convention are met in Hungary.

3.7 Assessment and certification of safety

3.7.1 The system of safety analysis reports

According to globally accepted international practice, the system of safety analysis reports is a vital element of the basic documentation guaranteeing safety.

The method of preparation and application of safety analysis reports is prescribed by a 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 guidelines of the Reg. Guide 1.70 of the US NRC taking national characteristics into consideration.

Govt. Decree 108/1997. (VI. 25.) 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 Report on the results of this assessment to the Authority. In the Periodic Safety Report, the Licensee presents the factors determining the operating risk of the installation as compared to those contained in the Final Safety Analysis Report. This serves as a basis for the Operating License. If needed, the Licensee takes safety-improving measures to eliminate or moderate risk factors. The Licensee proposes a programme of safety improvement measures, which includes the establishment of deadlines, and it submits this programme to the Authority as part of the Final Safety Analysis Report.

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

3.7.2 In-service inspections and tests, material testing

The in-service inspections and tests as well as tests and periodical material testing associated with overhauls are painstakingly carried out in Paks NPP. A detailed description of these tests is given in Annex 1.

3.7.3 Ageing management of equipment

In the Nuclear Safety Regulations issued as annexes to Govt. Decree 108/1997. (VI. 25.) Korm., separate sub-sections are designated to the topics of ageing and lifetime management. Ageing management of equipment in Paks NPP is being performed according to the Nuclear Safety Regulations. Its detailed description can be found in Annex 2.

3.7.4 Seismic safety

The reviewing of seismic safety of Paks NPP began in 1986. The plant performed the evaluation of seismic safety in two phases:

- Between 1993 and 1996, until the end of the site evaluation the “easy-fix” project was in progress. Within the “easy-fix” project such mechanical reinforcement of the existing equipment and building-structure elements was performed that increased the seismic resistance of the given equipment to the necessary level. As a result of the project the seismic safety of the plant was increased significantly.
- Between 1996 and 2002 the total review and the implementation of the complex reinforcements took place, up to the final seismic input.

The important elements of the second phase were:

- seismic resistance calculations of the buildings, inspection of the stability of the basement, elaboration and design of the reinforcements;
- evaluation of seismic resistance of the whole technology necessary for the implementation of seismic safety, elaboration and design of the reinforcements;
- implementation of reinforcements and modifications.

Evaluation of the seismic resistance and the implementation of the prescribed reinforcements were fully completed by the end of 2002. In 2002 the complex testing of the cool-down technology, elaborated in order to implement seismic safety, took place and the Authority granted the license for its future application.

As from 2003 the seismic safety of Paks NPP meets the requirements prescribed by the International Atomic Energy Authority.

Earthquake alarm and protection system

In addition to free-field measurements, several triaxial acceleration gauges are located within each twin unit: three of them are practically 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.

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 the Technical Specifications and in the Emergency Operating Procedures of the reactor.

3.7.5 Periodic Safety Review

The International Atomic Energy Agency issued its recommendations concerning Periodic Safety Reviews in 1994 (Periodic Safety Review of Operational Nuclear Power Plants, Safety Series No. 50-SG-O12). This recommendation schedules regular reviews approximately every ten years thereby providing a comprehensive view of the safety of the nuclear power plant units and, by virtue of their systematic approach, they are suitable for defining the necessary safety improvement measures and priorities.

In Hungary, the Authority issued a decision and a Guideline about Periodic Safety Reviews. The Guideline sets the objectives, principles of implementation, legal regulation, and technical background of the review and its related documents.

In the regulatory decision concluding the review carried out during the previous term of reporting, the Authority extended the validity of the long-term safety operation license of Units 1 and 2 of Paks NPP up to 31 December 2008.

The Authority added to the improvement list of the power plant and prescribed 100 improvement measures. Of these, 15 are such whose delayed accomplishment would automatically suspend the validity of the operating license, 50 measures are such that their delayed fulfilment may entail a penalty.

The operator performed the Periodic Safety Review of Units 3 and 4 of Paks NPP in accordance with the Act on Atomic Energy and the related regulations. The licenses of these units are valid until 31 December 2010. An important novel addition to previous approaches was that the scope of the review is supplemented by two additional elements: analysis of environmental radiological effects and nuclear emergency preparedness.

In the official disposition concluding the Periodic Safety Review the Authority prescribed 65 improvement measures, 15 are of such whose delayed accomplishment would suspend the validity of the operating license.

3.7.6 Major measures taken to improve safety

Paks NPP embarked on a procedure aimed at improving safety in 1986. Initially, the procedure focused on the assessment and preparatory work related to carrying out the measures recommended by the Soviet supplier, but the sphere of measures aimed at improving safety was gradually extended.

The Periodic Safety Review completed for Units 1 and 2 verified that the establishment of priorities approved by the Authority and the power plant was correct. The Review also provided a legal framework for the accomplishment of the necessary measures. The Periodic Safety Review for Units 3 and 4 added further measures to the list.

Up till the end of 2000 the following major safety improving measures had been taken:

- reconstruction of the sumps of the containments;
- installation of hydrogen re-combiners inside the containment, designed for design basis accident conditions;
- inhibition of the refilling of the tanks of the low-pressure emergency core cooling system;
- relocation of the auxiliary emergency feed-water system and the arrangements for its proper protection - (the failure to solve this problem used to be the containment's greatest risk factor);
- construction of a system for gas removal from the primary circuit;
- reconstruction of the uninterruptible electrical supply system (replacement of motor-generator sets);
- elimination of artificial loss of voltage in the case of abnormal events entailing ECCS (Emergency Core Cooling System) operation;
- establishment of the technology of emergency bleed and feed in the primary circuit;
- reinforcement against earthquakes in the primary circuit.
- refurbishment of the reactor protection system;
- replacement of the primary-circuit safety valve system for the pressure protection and bleed-and-feed functions;
- introduction of the symptom-based system of emergency operating procedures;
- certification of the adequacy of the localization tower (Annex 3);

From the formerly launched programmes, one of the tasks of the upcoming years will be the implementation of the following measures:

- construction of a post-accident sampling system;
- management of primary-to-secondary leakage.

Thanks to the implemented measures the safety of the units has further increased. Paks NPP Ltd performed an analysis of the fire and flooding events evolving inside the technology. The core damage frequency - due to the initiating events evolving inside the technology, which is the most characteristic safety indicator of nuclear power plant units - has been decreased to half of the original value for both the operating reactor and the reactor shutdown for refuelling or maintenance. The annual average probabilities of core damage originating from the assumable incidental situation as a consequence of events including all operating states (full power operation, shutdown states during refuelling or overhaul), of an internally caused system- or equipment failure, inadequate human interactions, internal origin fire and flooding were, in 2003, for the four units in sequence: $3.8x10^{-5}$; $3.3x10^{-5}$; $4.4x10^{-5}$; $3.6x10^{-5}$.

Paks NPP Ltd performed the seismic assessment of the selected reference unit and it determined the value of the anticipated core damage frequency. By virtue of the significant similarity and architectural identity of the units, this value is valid for the other units as well. The calculated average value of core damage frequency of a unit of the nuclear power plant originating from the accident scenario postulated as a consequence of an earthquake is $2.87x10^{-4}$ per a year.

Based on Chapter 3.7, it can be stated that Hungary meets all requirements stipulated in Article 14 of the Convention related to the assessment and verification of safety.

3.8 Radiation protection

3.8.1 Regulatory framework

As far as general radiation protection is concerned, the Act on Atomic Energy allocates regulatory, official and professional administrative tasks to several ministries. The regulation of radiation protection (radiation protection directly affecting humans) belongs to the Ministry of Health, Social and Family Affairs, the technical side of plant radiation protection is the task of the Authority, the issue of releases and thus the protection of the environment belong to the Ministry of Environmental Protection and Water, while tasks related to the radioactivity of the soil and the vegetation belong to the scope of the Ministry of Agriculture and Rural Development.

The major regulations that are currently applied in the field of general radiation protection are as follows:

- The Act on Atomic Energy defines the legal responsibilities of the users of nuclear energy and of the authorities.
- Decree 1/1980. (II. 6.) OKTH of the National Commission on Environmental Protection regulates the atmospheric emission of the nuclear power plant, while the limits and other conditions of liquid discharges were defined in the water use license for Paks NPP by the regionally competent environmental and water resources administration during the licensing procedure of the nuclear power plant.
- Govt. Decree 108/1997. (VI. 25.) Korm. focuses on the technical part of radiation protection at nuclear power plants.
- Decree 12/1998. (XII. 11.) EüM of the Minister of Public Health relates to the allowable radioactive contamination content of foodstuffs. There is no limitation prescribed regarding

the soil and flora; determination of limitation belongs within the scope of individual judgment.

- Decree 16/2000. (VI. 8.) EüM of the Minister of Public Health on the implementation of some decrees of the Act on Atomic Energy lays down the basis of radiation protection according to the recommendations of the ICRP 60 and the IAEA Safety Series-115.
- Decree 15/2001. (VI. 6.) KöM of the Minister of Environmental Protection regulates radioactive releases and their inspection during the application of atomic energy.
- Decree 47/2003. (VIII. 8.) ESZCSM of the Minister of Health, Social and Family Affairs determines the conditions of interim storage and final disposal of radioactive wastes.

Govt. Decree 108/1997. (VI. 25.) 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 Regulations that are appendices of the Decree.

Volume 1 of the Nuclear Safety Regulations defines the contents of the radiation protection related sections of the Preliminary Safety Analysis Report necessary for the request of the installation and operating licenses and that of the same section of the Final Safety Analysis Report. The same volume prescribes the regular analysis of the radiation protection indicators of the operation and the utilization of the 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 the requirements towards dosimetry control systems, shielding, and systems influencing radioactive emission.

Volume 4 summarizes the requirements concerning the execution and documentation of radiation protection activities. The same volume deals with the requirements relating to the handling of nuclear fuel and radioactive wastes.

Decree 16/2000. (VI. 8.) EüM 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 standard, which should be approved by the competent authority (the State Public Health and Medical Officer's Service in this case). The annexes of the Decree specify the limits of the doses of workers and members of the public; the radiation safety principles of workplaces, methods of radiation protection training; dosimetry control; the treatment of those suffering from a radiation injury; the tasks of the radiation protection service, the management of accidents, and the special radiation protection requirements for nuclear power plants.

Decree 47/2003. (VIII. 8.) ESZCSM prescribes 5 years of (renewable) service time for the interim storage of radioactive wastes, while regarding the operation of final disposal it prescribes 10 years (extendable). Concerning the final disposal, after closure, the public limit can be 100 μSv/year effective dose, and the risk limit can be 10^{-5} case/year.

3.8.2 System of dose limitation

The following table (3.8.2-1) summarizes the dose limits set in the domestic regulations.

Table 3.8.2-1 Annual dose limits for workers employed by the user of nuclear energy and for individual members of the public(1)

Dosimetry quantities	Subjects of exposures		
	workers (2) (above 18)	students and apprentices (3)	members of the public
Effective dose	100 mSv/5 years 50 mSv/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.
In 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.

3.8.3 Occupational exposure at Paks Nuclear Power Plant

Patterns of annual exposures

Based on the Workplace Radiation Protection Rule of the Paks Nuclear Power Plant, every worker employed in a radiation hazardous post (including both outside and plant employees) are inspected by a regulatory film dosimeter. Since 1 January 2002 the internal rules of Paks NPP have prescribed full-scope dosimetry inspection. In accordance with these rules, every such worker has to wear an electronic operative dosimeter that performs the activity within the controlled area. Those working in the so-called Health building are exempted from that rule. However those personnel of the Health building who work in level „B” of the Radio-chemistry Laboratory, level „A” of the hot chamber row, and in the Meteorological Laboratory have to wear an electronic dosimeter. Dosimetry monitoring allows the continuous monitoring of radiation exposure and the determination of work level radiation exposure.

The following charts (Figs. 3.8.3-1, 3.8.3-2) demonstrate the patterns of the maximum individual doses of workers and the annual collective doses, based on the officially evaluated measurements of the film dosimeters.

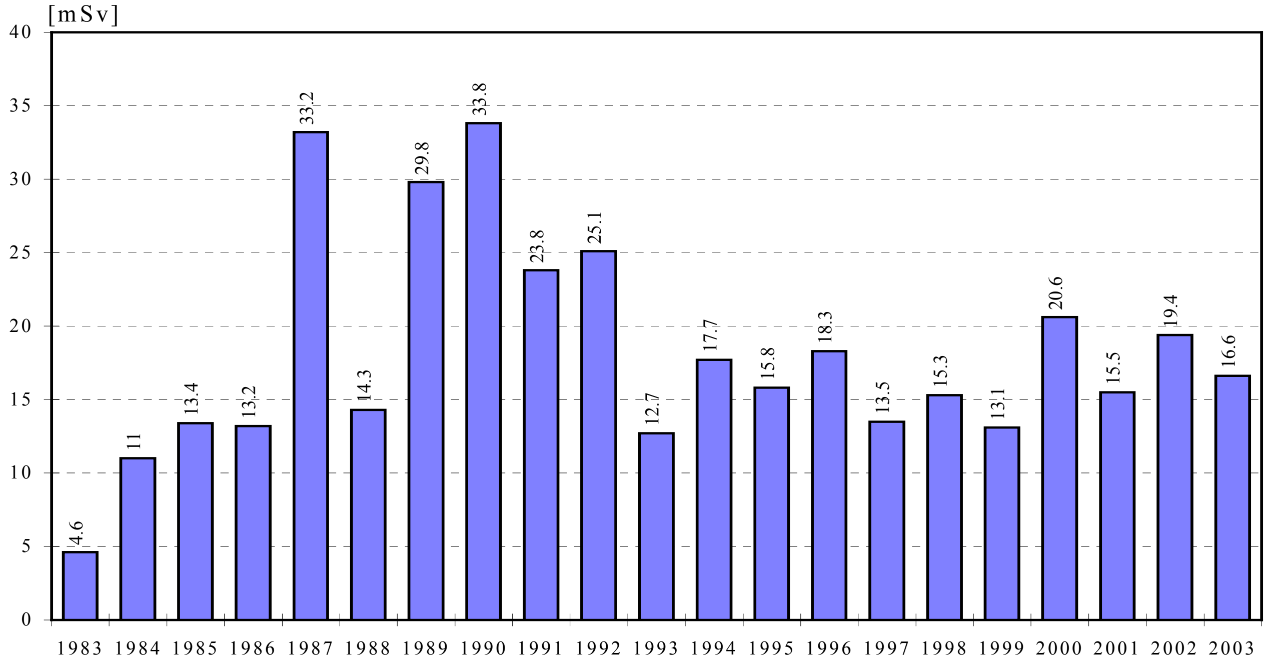

Figure 3.8.3-1 Maximum annual individual doses according to regulatory film-dosimeter readings

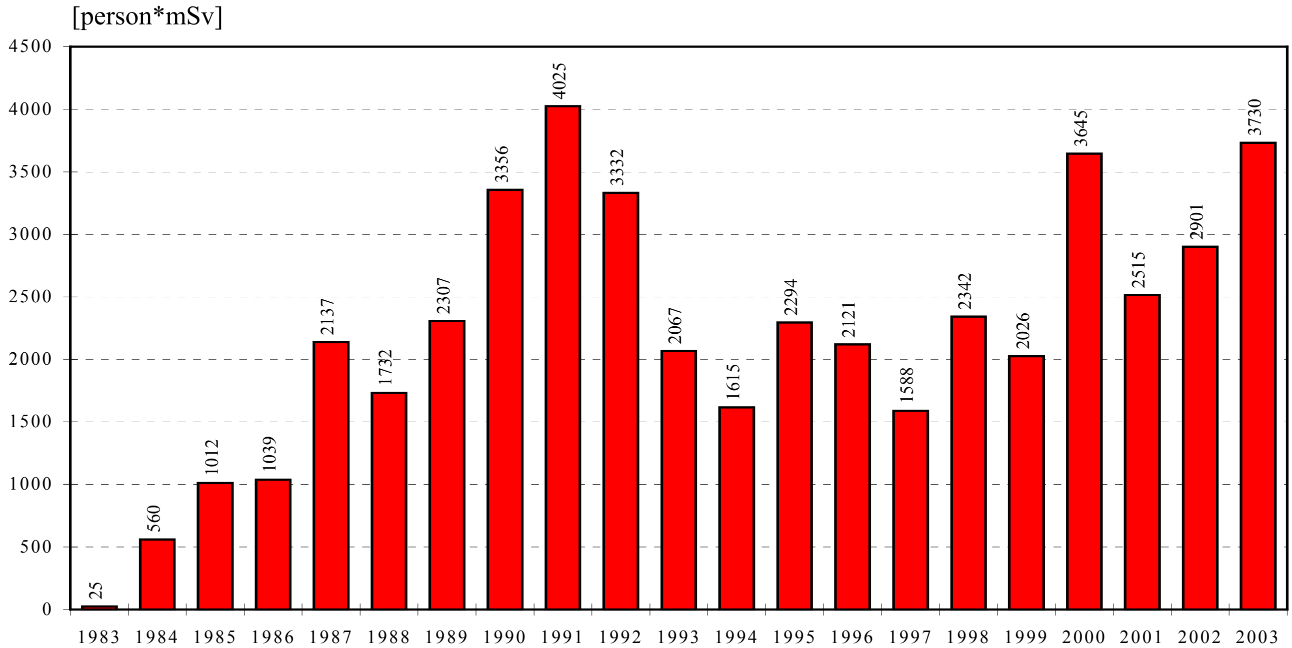

Figure 3.8.3-2 Annual collective doses according to regulatory film dosimeter readings

The increase of the collective dose in the year 2003 originates from the serious incident at Unit 2 and from the termination of its consequences (see Annex 7) and from the extra exposure related to the activities of the general overhaul of Unit 1.

Radiation exposure during the overhaul period

In Paks NPP most radiation exposure of the personnel originates from the overhauling activities during the 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 the 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 the main components and in the rooms involved in the overhaul works. 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 their dose values were determined on the basis of the operative dose values received at the power plant. Collective doses for 2003 were 1526; 755; 340, and 152 man*mSv for Units 1, 2, 3, and 4, respectively.

The plant also regularly controls the patterns of internal exposure, by thyroid and tritium excretion measurements and by whole body measurements. Internal exposure generally has a very low contribution to the annual exposure of workers. In 2003, internal exposure exceeding the recording level of 0.1 mSv was found in 11 cases. Concerning the tritium activity-concentration measurement in urine the recording level (2.5 Bq/cm^3) was reached or exceeded in 291 cases. The maximum concentration was 41 Bq/cm^3, which means 82 μSv committed effective dose, assuming that the sampling was performed on the 14^{th} day after the tritium intake.

The power plant itself performs the dosimetry control of employees engaged from outside companies.

Summing up, it can be stated 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.

Application of the ALARA principle

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

Among these administrative measures, the radiation protection training provided to workers employed in affected jobs should be highlighted. This comprises basic radiation protection training and further upgrading and supplementary courses, along with the regular examination of knowledge gained.

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 with particularly enhanced exposures, 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). The programs contain all technical and administrative measures that are needed to achieve the optimal radiation protection of the activity in question. A quantitative method was also introduced to optimize radiation protection in Paks NPP. The suggested quantitative methodology is the differential cost – benefit analysis deriving the optimum level by evaluating the costs of radiation protection versus the benefits of restricting exposure. For Paks NPP the standard cost for 1 man∗mSv is set to HUF 25000 for the time being, and this value is to be periodically revised.

3.8.4 Radiation exposure of the public in the vicinity of the nuclear power plant

Atmospheric and liquid release

The dose constraint of the most affected group of the population in the vicinity of the Paks site is 100 μSv/year (90 μSv/year for nuclear power units and 10 μSv/year for the spent fuel interim storage facility). According to disposition No. 1/1980 of the National Environmental Protection Office, the activity limits of atmospheric emission are as follows (see Table 3.8.4-1 below):

Table 3.8.4-1 Atmospheric radioactive emission limits for 1000 MWe power units

Radioactive substance	Emission limit [Bq/day] (1)
Sr-89 and Sr-90	$5.6 * 10^{4}$
Radioiodine isotopes, in I-131 equivalent	$1.1 * 10^{9}$
Total radioactive aerosols (with a half-life above 24 hours)	$1.1 * 10^{9}$
Radioactive noble gases (2)	$1.9 * 10^{13}$

Remarks:
(1) values apply to emission averaged over a 30-day period;
(2) in the case of simultaneous boric acid control of two reactors this value may achieve a maximum of $6.5 * 10^{13}$ Bq/day once a week.

Limits imposed on liquid discharges were defined in the water use license issued by the regionally competent environmental and water resources administration during the licensing procedure of the nuclear power plant. These values are shown in Table 3.8.4-2:

Table 3.8.4-2 Cumulative limits of annual liquid discharges for the four units

Radioactive component	Activity limit [GBq]
Gross beta	14.8
Sr-90 from the gross beta	0.148
H-3	$30*10^3$
Total alpha	~ below the detection threshold

The limits of atmospheric and liquid releases are basically identical to the design values featured in the technical designs of the nuclear power plant.

The release data of the plant related to the past ten years as a percentage of the regulatory limits are shown in Table 3.8.4-3. The values of the table demonstrate the increase of airborne release during the Unit 2 cleaning incident period. In turn, the effluent releases, due to the shutdown of Unit 2, slightly decreased (except strontium) compared to the previous years.

Table 3.8.4-3 Summarized data of releases as a percentage of regulatory limits

Year	Number of operating units	Airborne [%]				Effluent [%]		
		Noble gas (total)	Aerosol ($T_{1/2}$>24 h)	Iodine*	^{89,90}Sr	Total Beta	^{90}Sr	^{3}H
1994	4	1.4	0.11	< 0.1	0.8	7.4	0.51	61
1995	4	1.4	< 0.1	< 0.1	1.9	8.1	2.8	67
1996	4	0.6	0.1	< 0.1	3.3	5.5	3.2	65
1997	4	0.4	0.18	< 0.1	5.6	4.5	7.0	52
1998	4	0.5	< 0.1	< 0.1	2.2	6.0	6.1	66
1999	4	0.4	< 0.1	< 0.1	2.0	7.4	4.8	67
2000	4	0.6	< 0.1	< 0.1	0.4	7.7	1.6	61
2001	4	0.7	< 0.1	< 0.1	0.5	7.9	1.5	62
2002	4	0.4	< 0.1	< 0.1	0.3	8.5	1.3	73
2003	4	4.01	0.91	54.1	18.2	6.2	6.4	54.6
Regulatory limit		$1.9x10^{13}$	$1.1x10^9$	$1.1x10^9$	$5.6x10^4$	3.7	37	7.5
		[Bq/day]				[GBq/yr]	[MBq/yr]	[TBq/yr]
		for 1000 MW_e				for units		

* ^{131}I equivalent

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

The site of the power plant is divided into 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, rooms are classified into 3 categories according to permitted radiation levels and surface contamination. These are the manageable, restricted manageable and not manageable rooms. Radiation protection is continuously monitored on the premises of the plant by a radiation protection system with 500 measurement channels per twin-unit. The control includes the gauging of dose rates and air-activity concentrations in the rooms, and the measurement of the activity of different technological substances. Signals from the detectors are transmitted to the Dosimetry Control Room, where they are visually displayed with audio warning (alarm and emergency levels). The computerized display and archiving of measurement results also take place in this control room. 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 the stacks (iodine and noble gas activity, aerosol and airflow measurement), at the water sampling stations (total gamma activity, temperature, water flow measurement), at the meteorological tower, and at the environmental monitoring stations set up at about 1.5 km from the power plant (air iodine activity, dose rate). Data are transmitted to the above mentioned Dosimetry Control Room;
- *off-line* laboratory measurements serve to enhance the accuracy of the 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, dry-out, grass, soil, aerosol, ^{14}C, atmospheric tritium activities and doses.

In addition, sampling stations which measure dry-out activities and doses are situated within a 30 km radius of the nuclear power plant. Moreover, numerous samples are collected in the environment surrounding the power plant, e.g. mud, fish, plants, milk and soil. Measurements have so far shown only insignificant amounts of radioisotope activity generated by the nuclear power plant in the environment; the additional dose of the population from the emissions 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 the 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.

3.8.6 Radiation protection activities of the authorities

As described under Section 3.8.1, as far as general radiation protection is concerned the scopes of competence are shared among the HAEA, the State Public Health and Medical Officer Service and the Ministry of Environmental Protection and Water Management. With regard to the complexity of scope of the authorities and their interconnection, the HAEA signed an agreement with the National Medical Officer Board of the State Public Health and Medical Officer Service in March, 2003. Its objective is to harmonize the inspections, the investigations of technical radiation protection and radiation protection, and to ensure full scope supervision of these fields within the nuclear installations.

The Tolna County Institute of the State Public Health and Medical Officer Service regularly inspects the workplace radiation protection conditions of the nuclear power plant by involving the National Research Institute for Radiobiology and Radiohygiene as a professional body. The Tolna county office representatives of the State Public Health and Medical Officer Service, in accordance with the above agreement, fortnightly consults the resident inspectors of the HAEA NSD. Exchange of the actual radiation protection inspection records and experience takes place during these consultations.
Regular and unplanned 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:

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

The Alsó-Duna-völgyi (Lower Danube Valley) Environmental Inspectorate enforces the fulfilment of requirements related to discharge limits and other environmental stipulations contained in resolutions and 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.

The various, regionally competent County Veterinary Sanitary and Food Control Stations monitor the activities in soil, vegetation and foodstuff.

The Environmental Radiation Protection Monitoring System of the authorities performs independent 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 Collecting, Evaluating and Processing Center of the system was set up in the 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.

Concerning the April 2003 incident, the special bodies playing a role in the system gave an account of the release and its environmental and public impacts in a separate report. The most important statements of this report are as follows:

- the airborne incident releases (of strontium and iodine), exceeded the 30-day limit in the common stack of Units 1 and 2, by 4 times and 13 times respectively (other components of the release were below the limits);
- the effluent releases did not exceed the time proportional limits;
- except for the direct vicinity, i.e. the area of the operational monitoring system, of the plant the impact of the releases was detectable only in small part of the samples (the detection limits of radio-iodine were exceeded only a few times in some aerosol and grass samples);
- the maximum value of public radiation exposure did not exceed the value of 140 nSv (the population dose limit related to the plant releases is 90 μSv).

Based on Chapter 3.8, it can be stated that Hungary makes every possible effort to maintain radiation doses at the lowest reasonable level achievable, and thus fulfils all those requirements stipulated in Article 15 of the Convention.

3.9 Emergency preparedness

3.9.1 Regulatory framework

Act LXXIV. of 1999 prescribes a uniform system of protection against all kinds of emergencies. Govt. Decree 248/1997. (XII. 20.) Korm., amended by Govt. Decree 40/2000. (III. 24.) Korm., regulates the organization and tasks of the National System for Nuclear Emergency Response as well as the scopes of duty and competence of the Hungarian Atomic Energy Commission and the Authority in agreement with modern public administration structures. Govt. Decree 165/2003. (X. 18.) Korm., promulgated upon the accomplishment of the EU harmonization process of the legal system, is compatible with Council of the European Union directive 89/618/EURATOM on the topic of informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency.

3.9.2 Operation of the national nuclear emergency response system

The protection against disasters is managed by the Governmental Co-ordination Committee.

The composition of the Governmental Co-ordination Committee is as follows:

- president: the Minister of Interior;
- vice president in case of a nuclear emergency: the Director General of the Hungarian Atomic Energy Authority;
- members: the administrative state secretaries of the ministries involved in the emergency and the head appointed by the minister without portfolio governing the national security services.

The bodies of the Governmental Co-ordination Committee are the Secretariat, the Operative Staff, the Emergency Center, the Defence Working Committee, and the Scientific Council.

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

The Secretariat of the Governmental Co-ordination Committee, and in the event of an emergency its Operative Staff, operates within the Ministry of Interior, its Emergency Center operates on the basis of the Directorate General for National Emergency Management of the ministry.

A state of nuclear emergency is declared or withdrawn by the president of the Governmental Co-ordination Committee or, in case of urgency and for the area under his control, by the chairman of the County (Capital) Local Committee for Nuclear Emergency Response, based on the information received from the plant.

If a nuclear accident occurs, it is the task of the Defence Working Committee to provide the decision-makers with decision support (until the Defence Working Committee is set up this task is performed by the Operative Staff). The Committee is activated on the base of the Ministry of Interior, its head is appointed by the state secretary of the Ministry of Interior, members are appointed by high ranking officers of corresponding ministries and bodies of national competence. The Hungarian Atomic Energy Authority operates an expert panel within the Defence Working Committee in the case of a nuclear emergency.

The employment of intervention forces is subject to the recommendation of the head of the Operative Staff. The Operative Staff consists of the delegates of the Directorate General for National Emergency Management of the Ministry of Interior and the corresponding ministries. The head of the Operative Staff is appointed by the Minister of Interior.

Members of the nuclear emergency section of the Scientific Council of the Governmental Co-ordination Committee are invited to serve on the Council by the Director General of the Hungarian Atomic Energy Authority. The main duty of the Scientific Council is to offer technical and scientific aid to support the decision-making process and the decisions themselves in order to enhance emergency preparedness and to handle the consequences of an emergency.

Within the nuclear installation, the person responsible for the implementation of tasks related to the response to an accident is the chief executive of the installation; in the counties and in the capitol the chairman of the regionally competent County (Capital) Local Committee for Nuclear Emergency Response, while at national level it is the chairman of the Governmental Committee.

For a nuclear emergency, it is the task of the Hungarian Atomic Energy Authority to assess the current situation and then to forecast the likely nuclear and radiation situation and its propagation. Information to support the assessment and decision-making are provided by the following organizations:

- the Center for Emergency Response, Training and Analysis of the Hungarian Atomic Energy Authority, which is in direct data communication contact with Paks NPP;

- the International Contact Point at the Authority;
- the Nuclear Emergency Information and Evaluation Center operated by the Directorate General for National Emergency Management of the Ministry of Interior;
- the Emergency Information Centre of the Nation-Wide Environmental Radiological Monitoring System working on the base of the Ministry of Health.

Nuclear emergency response organizations of various sectors and areas

The management and operating structure of the sector-wide system is determined by the corresponding ministers and the heads of bodies of national competence. It is the responsibility of the County (Capital) Local Committees for Nuclear Emergency Preparedness to set-up nuclear emergency preparedness bodies for each sector, to designate the forces and equipment needed to implement protective actions and to prepare and continuously maintain the emergency response action plan.

3.9.3 The National Emergency Response Plan

The modernization of the National Nuclear Emergency Response Plan, effective from 1994, became necessary in order to utilize the experience of the international and domestic nuclear emergency preparedness exercises implemented during the recent years, and to take into account the development of the legal background and changes of the national emergency response system since the existing plans had come into effect.

On the basis of the above and in harmony with the recommendations of the International Atomic Energy Agency (TECDOC-953 and TECDOC-955), a new National Nuclear Emergency Response Plan was elaborated, which is of multilevel type; the Emergency Response Plans of the nuclear installations, of the counties, of the sectors and of the bodies with nationwide jurisdiction, to be elaborated under its umbrella are built upon each other.

At its 18 November 2002 meeting, the Governmental Co-ordination Committee approved the National Emergency Response Plan as a model plan for the preparation of the different level Emergency Response Plans. The basic objectives of the National Emergency Response Plan are:
- reduction of the risk of nuclear or radiological accidents, or mitigating their consequences;
- prevention of severe deterministic health effects;
- reduction of the probability of stochastic effects.

The scope of the National Emergency Response Plan includes the knowledge and duties corresponding to the operation of the National Nuclear Emergency Response System. Its principal components are the following:
- the emergency design basis (summary of the accidents and phenomena entailing nuclear emergency for the installations of the different planning categories);
- organizational responsibilities (role and responsibility of the organizations, participation in the nuclear emergency response, in the mitigation of the emergency consequences);
- principles of emergency operation (description of the operation of the nuclear emergency response system in the different phases of the emergency);

- preparatory tasks (tasks connected with the review of the plans and with the nuclear emergency training courses).

Other relevant information belonging to the scope of the National Emergency Response Plan is contained in the Annexes of the plan. These are:
- Detailed description of the responsibilities and resources of the sectors;
- Nuclear installations, special radiation sources and their significance concerning nuclear emergency response;
- National intervention levels and planning zones in Hungary;
- System of nuclear emergency response plans, requirements for and main aspects of the content and structure of the other plans;
- Emergency monitoring strategy;
- Alerting procedure applied at Paks NPP;
- Detailed descriptions of the emergency situations considered in the course of planning.

The completed new nuclear emergency response plans, with the relevant laws harmonized with the EU requirements, based on the statement of the Governmental Co-ordination Committee, will be tested in 2004, within the framework of a national nuclear emergency exercise.

3.9.4 The 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 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 the emergency situation. The classification of an emergency situation entails the implementation of the predefined measures of a given class. Classification enhances the uniform international and domestic understanding and handling of the severity of the emergency.

In an emergency, the actions determined upon the declaration of the emergency class shall be introduced or shall prepare for their introduction in the zones designated by concentric circles around the installation. Among the planning zones, the smallest in radius, 3 km, is the “precautionary protective action planning zone”, in which the measures to be introduced shall be implemented without undue delay with the necessary preliminary arrangements. This circle is surrounded by the next, 30 km, circle within which the “urgent protective action planning zone” can be found; and then the largest one, of 80 km, the “long term protective action planning zone” is located. Concerning the latter two, special laws determine the intervention levels, the taking into account of which shall be provided for determining the protective actions to be introduced.

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

Comprehensive Emergency Response and Action Plan of Paks Nuclear Power Plant Ltd

The emergency preparedness of the power plant is based on the Comprehensive Emergency Response and Action Plan. The plan contains the organizational and technical measures aimed at the assessment, limitation and management of nuclear, radiological and conventional emergencies. The structure of the plan is modular; besides the regulation of the general emergency operation it contains different modules for the different types 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. The emergency tasks and the necessary resources are specified in emergency response scenarios In the plant an alarm system ensures the rapid activation of the Emergency Response Organization.

The plan prescribes the order of internal and external alarms 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 for emergency response. The detailed regulation of the prescribed tasks is contained in the modules, related procedures and implementation instructions of the plan. The plan also sets down the regulations concerning the preparation, training, and exercises of the personnel.

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

The system of providing the public with appropriate information in the event of a nuclear emergency; media relations

The protection of the public is the task of the authorities, but in the early stages of an accident the power plant itself faces duties of this nature.

In case of an actual emergency, the public is alerted by an acoustic alarm and information system installed within a 30 km radius of the power plant. In the event of an emergency, it is the duty of the national media to give appropriate information, but the power plant is also ready prepared to issue press releases and to notify the public via the media, i.e. through local and nation-wide radio, television and press, in agreement with the Authority. As a means of providing rapid information, the mayors of the settlements located in the vicinity of Paks NPP and the authorities involved in the emergency response receive SMS notification as well, detailing the related events of the plant. The nuclear power plant is represented in the working group of the Governmental Co-ordination Committee.

Supported by the Paks NPP 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 the emergency preparedness activities of the Paks NPP based on the links with national media.

Order of preparation and exercises

On-site and off-site exercises, including national and international exercises, are organized regularly in accordance with annual plans as defined in the Emergency Action Plans.

The entire personnel of the power plant are in readiness for potential emergency tasks. The members of the emergency response organization receive regular training to handle their specific tasks. The power plant carries out its own exercises based on an annual exercise schedule that is approved by the Authority. Exercises maybe alerting exercises; practices when different organs of the Emergency Response Organization are prepared for their tasks; or system exercises when tasks are accomplished in co-operation with county-based or national bodies.

Certain sectors organize part-exercises independently of the central administration. In addition, the Emergency Action Plans prescribe the regular testing of the reliability of communication systems.

Hungary as a Member State of the OECD Nuclear Energy Agency regularly takes part in the international nuclear emergency exercises called INEX. After the closure of the INEX 2 exercise series, Hungary also participated in the INEX 2000 international exercise, which significantly contributed to the reinforcement of the emergency response capabilities, and to the identification of the remaining tasks and weak points. Similarly, Hungary is a regular participant of the CONVEX nuclear emergency response exercises organized by the International Atomic Energy Agency. Based on the statement of the Governmental Co-ordination Committee on 21 January 2002 preparations for a national nuclear emergency response exercise were launched.

Since September 2003, Hungary - as a full member of ECURIE (the early notification arrangement of the EU in case of nuclear emergencies) - also participates in the exercises organized within the framework of the ECURIE system.

As a result of what has been said above and of the regional projects of the International Atomic Energy Agency, aimed at the harmonization of the emergency preparedness of the region, the level of emergency preparedness in Hungary complies with the international recommendations and it is comparable with that of other European countries operating similar nuclear programmes.

3.9.5 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 in the case of a nuclear emergency;
- the Convention on providing assistance in the event of a nuclear or radiological emergency.

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, which came into force in Hungary on 27 April 1992.

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 the emergency preparedness and response launched by the International Atomic Energy Agency. This project provided significant assistance to the revision and renewal of the Emergency Response Plan.

The establishment of co-operative relations with the professional bodies of the European Union was an integral part of our accession. As an important step to the co-operation, the preparatory negotiations were finished and Hungary on 14 September, 2003 joined the ECURIE emergency early notification system.

Bilateral inter-governmental agreements

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).

On the basis of Chapter 3.9 it can be stated that the emergency response system stipulated in Article 16 of the Convention is available in Hungary.

4. THE SAFETY OF INSTALLATIONS

4.1 On-site and off-site factors

Volume 2 of the Final Safety Analysis Report completed in 2000 analysed the features of Paks NPP`s site in detail, the related new findings, and the changes in the environment. Currently the re-assessment of the coincidence of the external environmental impacts, the re-evaluation of the extreme meteorological conditions, and further analysis of the site-specific features are under way.

4.1.1 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 Highway No. 6. Its geographical co-ordinates are 46°34'24" (northern latitude) and 18°54'53" (eastern longitude). The area of the site is 585 ha, it is the property of 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 main technological components reach the power plant by road, rail or by water.

4.1.2 External man-made hazards

The region is mainly characterized by cultivated land. There is no significant industrial activity in the immediate vicinity of the site. 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; however, flying is completely prohibited within a 3 km zone around the power plant. Based on conservative estimates the probability of military aircraft crashing and falling on the most sensitive 100,000 m^2 area of the nuclear power plant is $3.2*10^{-7}$/year.

Analysis of road and waterway accidents during the transport of hazardous substances, indicates that the probability of the release of hazardous substances by road accidents is $4.8*10^{-7}$, that of a poisoning is $3.1*10^{-7}$, while that of an explosion is $2.6*10^{-7}$ events/year. In the case of transport by water, a conservative analysis regarding the probability of water-related accidents and release of substances resulted in less than 10^{-7} events/year.

4.1.3 Population

A comprehensive demographic analysis prepared in 1973 revealed the development trends of the settlements within the vicinity of the power plant along with the influencing factors defined the anticipated number of the population and its regional distribution. It also assessed the expected scale and nature of tourism and recreation within the vicinity of the power plant and related areas.

The original analysis has been revised several times during the past years. Modifications have been made in order to update the regulation and to adopt the new international recommendations.

The population within a 30 km radius of the nuclear power plant numbers approximately 200,000.

4.1.4 Meteorology

Judging from the measurements performed in Paks, the annual mean temperature is slightly increasing. The length of extremely cold periods (25 ^{o}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. The Paks meteorological station is often the one to 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.

The distribution of precipitation shows great variations, and this is obviously caused by the proximity of the River Danube.

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

Other effects (e.g. hurricanes) are so rare in the region that they were not even taken into account when the plant was designed.

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. Climatic changes do not affect the safe operation of the nuclear power plant.

4.1.5 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, that of the water speed is 1m/s, and that of the 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 the water use license issued jointly for the four units, the warming of the cooling water returned to the river may not exceed 11 ^{o}C, or 14 ^{o}C if the temperature of the water is below 4 ^{o}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 may not exceed 30 ^{o}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. The temperature of discharged water has never consistently reached these limit values during the operation to date.

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 in once every 10,000 years.

4.1.6 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.

Seismo-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 when designing the plant was 6 on the MSK scale based on the catalogue of historical earthquakes in Hungary and the isoseistic map that can be drawn from this. Seismicity is low in Hungary as a whole, even though stronger vibrations (with epicentral 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 earthquake hazard analysis based on a 10000 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 anSL-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 seen 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 the 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 a young river-water 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.

Based on Chapter 4.1 it can be stated that Paks and its surroundings meet the requirements of Article 17 of the Convention regarding siting.

4.2 Design and construction

4.2.1 Requirements concerning design and construction in the Hungarian system of regulations

Volume 3 of the Nuclear Safety Regulations issued as an appendix to Govt. Decree 108/1997. (VI. 25.) Korm. contains the general nuclear safety-related requirements concerning the design of nuclear power plants. The requirements lay down in detail the following principles and rules well known from international practice.

Multilevel protection

The principle of defence-in-depth should be applied to all activities related to safety, be it in relation to organization, operation or design, in such a way that any failure can be compensated for or corrected, and the occurrence of serious accident situations can be prevented. The levels of protection are aimed at maintaining the normal state of operation, preventing the development of accidents, and to mitigate the consequences of design basis accidents. Moreover, specific auxiliary systems and components shall be installed - for the further protection of the public and the operating staff - the task of which is to mitigate the consequences of occurrences and accidents beyond the design basis.

Application of technologies proven by experience and qualified by testing or analysis

Equipment for proven and verified technologies shall be available for the following cases:

- to shut down the reactor safely and to maintain it in a safe shutdown condition in each state of operation;
- to remove residual heat after shutdown;
- to reduce the emission of radioactive substances and to ensure prescribed limits of emissions.

Safety functions and the systems and components executing these functions should be classified into safety classes according to their influence on safety. The classified safety systems 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 operation, all constructions shall be tested, paying special attention to the new characteristics.

It is required that the scope to be determined of those safety-related systems and of components which should be designed to be inherently safe and - as far as possible - insensitive to any human error.

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 and components during normal operation, anticipated operational transients, and design basis accidents.
- An adequate communication system shall be established between different locations.
- The constant 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 prescribe the establishment of a unit control room, a reserve control room, and an emergency control room, and they also specify the requirements to be considered for their construction.

4.2.2 Fulfilment of requirements at Paks Nuclear Power Plant

Design principles applied when the power plant was constructed

The design of the 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. In spite of this, due attention was not given to the following: the basic design requirement related to protection against natural phenomena; the basic design requirement related to external dynamic effects; and the various basic requirements concerning the unit control room.

Fulfilment of up-to-date safety requirements

Paks NPP was designed in such a manner that during normal operation and in case of transients occurring relatively often, the first three physical protective barriers must not be breached (thus the fourth barrier 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. 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 the corresponding limits. The management of severe accidents that are more severe than design basis accidents but the probability of which are minimum was not directly taken into account among the design principles of the units.

The elements of the “defence-in-depth” principle were accomplished in the nuclear power plant according to the requirements of Soviet standards.

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

One of the improvement measures is the upgrading of the reactor protection. This large and complex project not only had safety enhancing objectives such as the installation of auxiliary protection and consistent physical separation but also included changes in devices, which changes were justified technically and economically. The refurbishment, using the most up-to-date control and instrumentation equipment, is being performed separately on each unit in consecutive years. As shown by experience so far, the new system, in accordance with the expectations, has significantly increased the sensitivity and reliability of the system.

Based on Chapter 4.2 it can be stated that the during design and construction of Paks Nuclear Power Plant the majority of the processes included in Article 18 of the Convention were followed, and the implementation of further safety improvement measures is under way.

4.3 Operation

4.3.1 Safety analyses

When Paks NPP was established and commissioned, Hungarian practices followed those accepted in the 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 the standards of the 1990's. The AGNES project was concluded successfully at the beginning of 1995 and brought reassuring results.

A comparison was made between the Preliminary Safety Analysis Report with the results of the analyses for off-normal events in the framework of the AGNES project. The AGNES project finally concluded that the power plant could be safely operated.

Analyses of the Periodic Safety Review performed for the four units were based on the above results of the AGNES project with the addition of some other elements.

The Periodic Safety Reviews embraced analyses of single failures and common mode failures, tests related to fire protection, flooding and pipe ruptures of high energy, and the assessment of the possibility of unintended boric acid dilution. Evaluation of the load bearing capacity of the airtight rooms included the hydraulic pressure and integrity tests of the containment and issues related to the sub-criticality of fuel storage systems. Systems and equipment related to safety have been qualified (the required environment-tolerance under accident conditions has been defined).

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

Details of the containment analysis are described in Annex 3.

Within the framework of level one PSA analyses, event trees and fault trees have been prepared concerning technological initiating events characteristic of the full power and shutdown states, and those concerning internal flooding, fire, high energy pipe ruptures and seismic initiating events. The value of core-damage probability was calculated and sensitivity and uncertainty analyses were performed. All probable external effects jeopardizing safety were assessed.

For determining the risk of large radioactive releases, a level two PSA was elaborated involving all formerly examined operating states and initiating events, except seismic impacts.

Within the framework of the review, accident analyses were prepared for the entire scope of design. The documentation of the Periodic Safety Review described the accepted methodology of analyses and also presented the results of the analyses that were performed. The list of initiating events that were applied included all initiating events considered to be globally important plus the cases especially characteristic for WWER reactors. The most sophisticated and up to date computer programs were used for the analyses.

Based on the deterministic analysis of the basic accident scenario performed within the framework of the severe accident analyses conclusions were drawn about processes inside the reactor and phenomena inside the containment, including the distribution of radioactive substances. The document contains the strategy of accident management procedures to be elaborated.

As a result of the AGNES project and of the Periodic Safety Review, the Final Safety Analysis Report of the nuclear power plant could be re-issued.

The HAEA NSD, on repealing the Preliminary Safety Analysis Report, approved the first version of the Final Safety Analysis Report and accepted it as the valid safety analysis of the Paks NPP. Modification of the Final Safety Analysis Report is possible only with the NSD`s license.

The completed and approved document, despite certain deficiencies, represents a significant increase in the level compared to the Preliminary Safety Analysis Report. Beyond actualization, further modifications of certain chapters were deemed necessary by the HAEA NSD. Before performing this review the HAEA NSD requested Paks NPP to submit the quality assurance plan of the modifications. The plan was completed at the end of 2002, and the HAEA NSD ordered its realization.

The schedule of the modification of the Final Safety Analysis is connected to its actualization, which means in reality that only the actualized report shall be submitted to the Authority.

Implementation of the Periodic Safety Review of Units 1-2 and Units 3-4 took place separately. Consequently the improvement measures have also to be handled in two groups. The measures prescribed upon the implementation of the Periodic Safety Review of Units 1-2 also appeared after the Periodic Safety Review of Units 3-4. However, during the Periodic Safety Review of Units 3-4 such problems arose that are also relevant for Units 1-2, although they were not recognized in due time. Implementation of the improvement measures prescribed after the Periodic Safety Review of Units 1-2 has already mostly been carried out and the unresolved problems are connected with the corresponding measures revealed at Units 3-4, with a common deadline.

In the decisions closing the two reviews the Authority, besides prescribing improvement measures, allowed the operating license of the units to remain valid. The most significant improvement measures from the more than 20 tasks performed during the period of 2001-2003 are:

- introduction of the symptom-based emergency operating procedures;
- reconstruction of the primary pressure protection system;
- modification of the reactor protection system;
- management of primary to secondary leaks;
- accomplishment of the seismic safety related project.

It can be stated that most of the improvement measures prescribed during the periodic safety review were implemented, however a number of tasks are due to be completed by 2005.

If the tasks listed below are not implemented, it is possible that this might lead to the limitation or withdrawal of the operating license of the units.

	Task
1	Reconstruction of the systems for monitoring the emission and the environment.
2	Reconstruction of the fire alarm system.
3	The ventilation system of the electric adapter and relay compartments has to be examined, and it has to be ensured that the steam and water occurring due to a possible pipeline break in the turbine hall could not cause any damage to the electrical systems.
4	With regard to the environmental parameters of the installed equipment (temperature, humidity, radiation, electro-magnetic disturbance, possibility of water spattering, etc.) all those items of equipment have to be re-examined that received a partially qualified or only partially complied qualification within the design requirements valid for the given environment. If necessary conformance will be ensured by sanctions or legal action.
5	Replacement of sealing material at the boundaries of the hermetic area with silicon or, in several instances, with other sealing material.
6	Reduction of adverse influence of human factor, development and introduction of new, symptom -based emergency operating procedures.
7	Decrease of the consequences of primary to secondary leakage of the steam generator via adequate modification of protection and safety systems.
8	Enhancement of seismic resistance of the units.
9	Modification of the primary pressure relief system, introduction of “bleed and feed” processes, realization of protection against pressure thermal shock.
10	Modification of the reactor protection system with by introducing new protection functions and operating conditions, consistently applying specific design principles.
11	Experimental examination of the containment behaviour and development of further investigation programmes.
12	Extension of the application of Level 1 PSA to the areas of fire, flood and seismic events.
13	Comprehensive study of high-energy pipeline breaks
14	Finalization of accident management strategies
15	Elaboration of the procedure and tools assisting in the symptom-based accident categorization in two steps: a) with the application of the currently available technical tools, b) with the application of the critical safety function monitoring system and the symptom-based emergency operating procedures.

Commissioning instructions

The Preliminary Safety Analysis Report contained the detailed technical data of the 28 nuclear power plant components of crucial importance. It also features the technical requirements of manufacture, acceptance, and commissioning. These requirements are described in detail in Annex 4.

4.3.2 Technical Specifications

Paks NPP prepared its Technical Specifications in 1988 in line with the operating instructions in force at that time, the supplementary material obtained before then, the views of the main constructor, analyses issued by expert institutes, and the experience gained from operation.
It is the operator's task to constantly upgrade and update its Technical Specifications. Changes to be introduced must be approved by the Authority.

4.3.3 Internal regulations, procedures

The present power plant has a modern system of regulations that ensure efficient and safe operation through a chain of regulations, instructions and procedures. The regulations and procedures meet the requirements of the Quality Assurance Manual. Standards and implementation instructions have started to be processed on the power plant's Intranet as well.

The Quality Assurance Manual has been revised in such a way as to primarily contain requirements. These quality assurance requirements are to be integrated into the separate internal implementation instructions of the various professional areas. Within the regulations of emergency response, emergency classes have been defined more accurately and in a more up to date manner. The feedback of experience gained from emergency response exercises was implemented and the symptom-based emergency operating procedure systems that are comparable with international practice are also being elaborated. These actions are being carried out in co-operation with foreign power plants of similar type.

In 1999, along with the modification of the organization of the power plant its internal regulation system was also modified. The new regulation system, similarly to the organization, is based on the functional processes. This means that the functioning and the documents providing regulation are closely linked together and they determine the requirements for the processes. In that the organization itself is built onto processes, the whole functioning, regulation and organization of the power plant are process-based and transparent. This structure ensures the conformity with the environmental requirements imposed on nuclear energy along with the efficient realization of necessary interventions.

4.3.4 Emergency operating procedures

Since the commissioning of the first two units of Paks NPP, the basic administrative requirements for safe operation were constituted by the operating instructions provided by the suppliers of the plant and other conditions and limitations prescribed in the delivery documentation and in the operating manuals.

Since 1993, Paks NPP Ltd has participated as an observer in the work of the Lisbon Initiative aimed at preparing symptom -based emergency operating procedures. The initiative was launched by the United States of America and the interested states of the former Soviet Union. Its main aim was twofold: to substitute occurrence-oriented accident management instructions that had previously been applied by symptom-based ones, to prepare such symptom-based procedures with the assistance of the USA for all operators of WWER reactors.

The framework of the Lisbon Initiative did not warrant the necessary conditions for the preparation of instructions, therefore, in December 1996 Paks NPP entered into a contract with Westinghouse Europe (Brussels) concerning the preparation of a new instruction system. The procedure package has been completed; its validation was performed at the end of December 2000. After full training and qualification of the personnel, the system was, introduced in February, 2003.

4.3.5 Maintenance

The system and the types of maintenance, cycles

The maintenance of a power plant is an integral part of its operation, and this is always a task of vital importance to be accomplished by the operator. Maintenance affects the safety, availability, operational safety, efficiency, lifetime and the economic viability of the plant.

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

The system of maintenance and overhauls has remained unchanged, its detailed description can be found in Annex 5.

4.3.6 Technical support

Technical and preparatory bodies

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

- licensing of installation and utilization;
- definition of the scope, scheduling and cycle times of technological tests; preparation, review, revision and modification of test scenarios and programs;
- planning, preparation, control and co-ordination of overhauls, weekend maintenance, weekly operative tasks and in-service works and the setting of conditions thereof;
- plotting the changes arising in the states and conditions of significant technical equipment;
- inspection of the existence of licences, materials and parts and the handling thereof;
- computerized recording and archiving of documentation needed for the planning and implementation of maintenance, repairs, reconstruction and investment activities;
- technical inspection of the work performed by outside contractors;
- preparation of the components and systems for the safety inspections and ensuring the adequate conditions of these inspections;
- providing the technical base, licensing, planning and full scale implementation of modifications;
- operation and development of the computerized planning and documentation system;

- maintenance and updating of the "as-built" documentation;
- medium term planning and co-ordination;
- technical development.

Decision supporting committees

Standing or ad hoc committees may be set up to make recommendations concerning emerging tasks. The tasks and operation of such committees are prescribed by the entity establishing them. The major committees of a technical nature are the Technical Committee, the Maintenance Working Committee, and the Safety and Quality Management Committee.

Domestic and foreign support institutions

The nuclear power plant maintains close relations with all Hungarian companies performing support activities for it.

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.

Close relations are maintained with foreign companies of outstanding experience in nuclear technology. Some of these companies are: IVO/FORTUM, Siemens/FRAMATOME, Westinghouse, EdF, and Nuclear Electric.

Based on contracts currently in force, the general design services are provided by ETV-ERŐTERV Rt.; the chief consultant is the KFKI Atomic Energy Research Institute.

4.3.7 Reports to the Authority

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

Regular reports

- quarterly report: notifying the Authority of the state of operational characteristics, current issues of operation and factors affecting operation;
- annual report: based on the quarterly reports, but as more information is 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 having taken place in the installation;
- 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 such as minutes of meetings, etc.

Event reports

- events under the obligation of instant reporting are required to be reported within two hours following their occurrence; the INES classification of all events subject to reporting should be performed, and the relevant recommendation should 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;
- the occurrence-investigation report should be submitted to the Authority within 30 days of the occurrence of the event.

4.3.8 Feedback

Own operational experience

As operation and maintenance tend to be profession-specific so far as equipment and activities are concerned within the various professional areas (mechanical, instrumentation and control, electrical engineering), data collection and processing are separated as well. As a result of this, monitoring and the utilization of the data received also differ in depth and complexity. A joint database of failures from different professional areas 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 the replacement, modernization or modification of components or equipment. These data are used in the safety analyses as well. The power plant shows good indicators even by international comparison, as far as safety systems are concerned. 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 in 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, other events are investigated at professional level. From 1992 onwards, events are classified according to the INES scale, and previous events were also classified retrospectively. Since the year 2000, several events have also been analysed by probabilistic methods.

With regard to the four units of Paks NPP: in 2001 three events, in 2002 four events, and in 2003 three events received INES 1 classification. The serious incident entailing fuel damage on 10 April 2003, that occurred in connection with the chemical cleaning of fuel assemblies outside the reactor was classified as INES-3.

The results of investigations and the corrective measures are widely presented. In that responsible personnel and deadlines related to corrective measures are always indicated and known, such measures are always traceable. Not only single events but also trends are monitored as well, including changes occurring in 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 through simulator training. The constant and regular revision of the operating instructions and the Technical Specifications offers evidence of the feedback of operating experiences.

Once every quarter, the Safety and Quality Management Committee reviews the safety indicators, the experience of event investigations, and the status of accomplishment of all measures taken. The Safety and Quality Management 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.

Utilization of the experience of other power plants

It is of vital interest to Paks NPP to learn and make use of the operating and other experience imparted by other installations and international information sources. Paks NPP takes part in the work of large international nuclear organizations (International Atomic Energy Agency, OECD Nuclear Energy Agency). There exists closer co-operation by way of participating in the professional work of the various groups comprising the operators of nuclear power plants, such as the World Association of Nuclear Operators (WANO) and the Club of Operators of WWER-440. 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. Good examples of recent years are the co-operation with the Loviisa power plant in the framework of the fuel diversification project, or the exchanges of maintenance experience with other WWER plants.

Reviews by external entities

Since operation commenced, Paks NPP has paid great attention to international reviews. The measures aimed at eliminating deficiencies discovered through assessments or found to be necessary by outside experts greatly contribute towards improving power plant processes.

The following international reviews (see Table 4.3.8.-1) were carried out at Paks NPP:

Table 4.3.8-1 International reviews

Year	Subject of the review	Review performed by
Annually between 1984 and 1987	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; seismic safety programme – 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	
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

Paks NPP elaborated a Comprehensive Action Plan to handle the remarks formulated by the HAEA NSD, the IAEA, and the WANO in their investigation reports dealing with the incident at Unit 2 in April 2003.

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 2 or 3 years.

4.3.9 Radioactive waste

On 29 September 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; here, only the most important characteristics are cited.

The safe handling of radioactive wastes of the nuclear power plant is the responsibility of the entity generating the waste, i.e. Paks NPP 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.

The classification of radioactive wastes takes place in accordance with Decree 47/2003. (VIII. 8.) ESZCSM of the Minister of Health, Social and Family Affairs.

According to the Act on Atomic Energy and its executive decrees the responsible organization for the disposal of radioactive wastes and for the interim storage and final disposal of spent fuel together with the de-commissioning of nuclear facilities is the Public Agency for Radioactive Waste Management. Legally, the waste generating entities are obliged to create the 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 investigations. 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 waste from the power plant

The Radioactive Waste Treatment and Disposal Facility was opened in 1976 at Püspökszilágy (about 30 km from Budapest). This site receives the radioactive wastes generated in research, medical, and industrial institutions of the country. From 1983 to 1997 low level solid wastes generated by the power plant were transported to the above-mentioned site, within the framework of a contract concluded with the approval of the Authority. Since 1997, solid radioactive wastes from the power plant are not transported to Püspökszilágy. Therefore, until the establishment of the new storage facility for final disposal, safe interim storage will be accomplished at the nuclear power plant itself.

Disposal of a power plant's radioactive waste is of national concern, its safe solution is a governmental task for which an inter-ministerial project was initiated. The principal task of this project was to seek a site for a repository to dispose of low and intermediate level waste from the NPP.

Relying on the results of the preliminary surveys and safety analyses, a subsurface repository, in granite, (at Bátaapáti (Üveghuta)) turned out to be the safest solution. In view of this it was decided and subsequently endorsed by the Hungarian Atomic Energy Commission, that detailed investigations should be commenced there. Public support is constantly monitored by polls and judging from the surveys support still exists.

The research and excavating activities continued based on the expertise and recommendations. On 3 December 2003, the competent authority - the South Trans-Danubian Regional Office of the Hungarian Geological Service - approved the final report of the ground surface research performed between 2002 and 2003, and stated that from the geological standpoint the selected site, was adequate for the disposal of low and intermediate level wastes.

Based on the available analysis results, the installation can be constructed at a depth of 200-250 m below the surface - which means 0-50 m above sea level. Current plans indicate that the storage facility can begin operating in 2008.

Preparatory work for the final disposal of high level radioactive waste

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 programme was elaborated for further investigations of the region; this programme was approved by the minister disposing the Central Nuclear Financial Fund at that time.

Based on Chapter 4.3 it can be stated that Hungary and Paks Nuclear Power Plant Ltd meet the requirements prescribed by Article 19 of the Convention with regard to operation.

4.4 Plans concerning safety improvement

The present section summarizes the plans related to safety improvement and the measures to be implemented. These were already described in detail in the previous sections.

Implementation of certain of the improvement measures prescribed during the Periodic Safety Review of Paks NPP are due to be completed by 2005.

Of the earlier commenced safety improvement programs, implementation of the under-mentioned measures is among the tasks of the coming years:

- construction of post-accident sampling system;
- management of primary to secondary leakage.

Apart from the process modifications, an important element of safety improvement is the more careful consideration of the human factor.

The improvement measures decided upon after the serious incident on 10 April 2003 at Unit 2 are basically aimed at upgrading the safety culture and the operational procedure of the organization.

Within the framework of the Organization and Operation Development Program the implementation of a three-year action package was begun, the goal of which is also the improvement of the safety and operational culture of Paks NPP.

Modification of the Final Safety Analysis Report commenced in 2002, this work is still under way and is expected to be finished in 2004. One of the main objectives of the work is to produce such a state of the art document, which is able to serve as a basis for the licensing procedure of the service life extension of Paks NPP.

Annex 1

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 the systems, sub-systems and components of the nuclear power plant are regulated by the instruction of Paks Nuclear Power Plant Ltd.

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

- in-service technological test - this is the function testing of systems in standby state of operation while taking the lowest risk possible;
- unit shutdown technological test - to check the operability of components and systems taking part in the shutdown, and to obtain information for maintenance work;
- overhaul technological test - to check the operability and function of components and systems maintained during overhaul;
- unit start-up technological test - a full-scope test following maintenance;
- non-scheduled technological test – full-scope or partial testing necessary to verify 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. The specific dates and times of the performance of the 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 minutes evaluating the tests are the basic documents for verifying suitability. Evaluation is done by the organization responsible for the performance of the test. As a result of the evaluation, maintenance, reconstruction, quality assurance concepts and cycle times may be modified.

All minutes of operational technological tests have been kept by the power plant since 1992 and they have been processed in detail.

Over a period of time the in-service tests performed have verified the adequate availability of components, systems and 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 a given unit, tests are scheduled to check the systems necessary for shutdown and cooling;
- *during* the overhaul of a given unit, upon completion of the maintenance of the safety systems, the adequacy of these are tested before handing over the next system for maintenance;
- *after* the overhaul of a given 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 test of the systems;
- full logical and real functional testing of protection systems;
- the hydraulic pressure test of the main cooling circuit and of the steam generators, depending on cycle times;
- the integral tightness test of the hermetic zone;
- criticality tests on the reactor, in order to verify the physical calculations;
- 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.

System of requirements relating to material testing

In Paks NPP, the unified program 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. The documents are revised yearly and necessary changes are made.

One of the guidelines of the Nuclear Safety Regulations following the entry into force of the new Act on Atomic Energy (1996) prescribes the performance of periodic material testing on nuclear power plant components. The guidelines stipulate that the scheduling of nuclear power plant tests should be set in material testing framework programs; their execution should be set in the testing technologies; and the requirements concerning evaluation should be laid down in a list of criteria.

Periodic material testing

The scope of periodic testing is defined by the material testing programs, which specify the testing area, the method of testing, the scope and frequency of testing, reference to the corresponding item of the list of criteria, the 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:

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

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

Annex 2

Ageing management of equipment

Basic concepts of ageing management

The nuclear power plant meets the official requirements related to ageing management in such a way that creates the possibility to maintain the safe conditions of operation of the power plant even beyond the design lifetime (30 years) of the plant. This concept is in accordance with

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

With regard to certain selected components considered to be critical, Paks NPP carries out systematic ageing management activities. The strategy includes:

- identification of critical components;
- definition of the zones of those components that are particularly prone to ageing, along with all potential degradation processes that are characteristic of the given part;
- consideration of the actual values of stressors to which the component is subjected;//
- revision of structural, review, maintenance, and material testing programs and their modification if required;
- establishment of a condition monitoring system for the components;
- continuous monitoring.

The activities above are in harmony with the requirements derived from the following guidelines issued by the HAEA NSD:

- Regulatory supervision of the ageing management program;
- List of equipment falling within the scope of the ageing management program;
- Quality assurance during ageing management of nuclear power plant components;
- Consideration of ageing effects during the design of nuclear power plants;
- Consideration of ageing effects during the operation of nuclear power plants.

Selection of critical components

The components screened for the ageing management were selected primarily during the review of the 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 (the principle of defence-in-depth). During the selection procedure, the document of the International Atomic Energy Agency entitled "Methodology for the Management of Ageing of Nuclear Power Plant Components" together with the related guidelines of the HAEA played important role.

Accordingly, only those items were included in the list of critical components that demand long term ageing management because of their unique characteristics, or the replacement of which would constitute a serious financial and technical challenge. The components considered to be critical are as follows:

- reactor pressure vessel;
- pressurizer;
- pressurizer surge line;
- pipelines of the main cooling loop;
- steam generators;
- main circulating pumps;
- main closing valves;
- feed-water pipeline;
- auxiliary emergency feed-water pipeline;
- ECCS hydro-accumulators;
- ECCS pneumatic valve;
- high pressure ECCS pumps;
- safety cooling water tank;
- reactor internals;
- hermetic zone concrete structures and coatings, the reactor support, and sealed hermetic penetrations;
- driving mechanisms of the control rods;
- pneumatic valves at the hermetic zone boundary;
- low pressure ECCS pumps;
- spray system pumps;
- safety cooling water pump;
- emergency feed-water pump;
- feed-water pump;
- power supplies for safety equipment (cables and connections).

Procedure

In accordance with the procedure the main tasks of the responsible organizational units of the power plant are as follows: to ensure the safe operation of the units during their scheduled lifetime, to ensure the availability of the units, to examine technical problems related to the ageing of components of distinct importance, to allocate tasks related to ageing management and co-ordinate the accomplishment thereof.

Cycle numbers

One of the administrative limitations for the operation of a critical component comes from the cycle numbers defined in the Technical Specifications. The cycle numbers of certain stressors were determined at design, thus both their rate of decrease and the actual load may be different from those scheduled. It should also be taken into account that such loads may arise that were not considered at design (e.g. thermal stratification due to stagnating flow).

Fatigue monitoring is an important task and it also provides the possibility to reassess the administrative limitations defined during design, which may be an important factor for potential lifetime extension.

Annex 3

International survey on the containment

On the initiative of the OECD and the European Union an experimental project was launched to investigate whether the containment supplied with a bubble condenser performs its designed function.

The Bubble Condenser Experimental Qualification (BCEQ) project specified two kinds of experiment to be performed and these were accomplished within the framework of the project PHARE/TACIS 2.13/95.

In the first series of experiments the thermal-hydraulic behaviour of the bubble condenser and the dynamics of related building structures were studied during the maximal design basis accident (Large break LOCA). The experiment was performed at the EREC organization in Russia. The bubble condenser of Paks NPP was taken as the model for designing the experimental equipment.

The second series of experiments studied the integrity of the steel structural elements of the bubble condenser under the conditions of a design basis accident, with static load. These experiments took place in Slovakia at the VUEZ institution. When designing the experimental model the structure of the Dukovany and Bochunice power plants was followed.

The third part of the project, conceived later, involved experiments on small-scale models for studying analytically several partial effects, accomplished at the SVUSS organization, Bechovice, Czech Republic.

The report summarizing the results of the experiments was presented in December 1999 in Brussels, at the session of the Technical Advisory Committee of BCEQ, and later in April 2000 in Berlin, at the meeting of the OECD Support Group.

The results gave favourable answers to most of the questions raised. However, a set of unresolved problems and uncertainties remained. Aimed at their removal, Paks NPP Ltd. concluded a contract with the Institute for Electric Power Research Co. (VEIKI), Hungary to perform several technical computations based on the test results. The software package GASFLOW 3D was used and the results were in good agreement with the data acquired during the experiments. Thus, the uncertainties concerning the flow and temperature distributions could be resolved.

Based on what has been said above it can be concluded that the BSEQ tests and the consecutive calculations proved the functionality of the Paks containment in accordance with the design in case of a large break LOCA event.

In spite of the results, positive so far, it seems to be expedient to perform several additional experiments to further validate the codes used for simulating the containment processes. The question was raised by the OECD Support Group that the possible occurrence of condensation oscillation should be considered in case of small breaks. Therefore the continuation of the examinations was prescribed by the HAEA NSD for the Paks NPP.

Since the standpoint of the Hungarian regulator was also the standpoint of the Czech and Slovak regulators, in August 2001 Paks NPP Ltd. initiated the establishment of an international consortium to perform the experiments. The participants (Paks NPP, Dukovany NPP, Bohunice NPP and Mochovce NPP) signed a trilateral contract, agreeing to jointly undertake three additional experiments on the EREC test facility. The NPPs carried out the design and preparation of the experiments together with their support institutes (VEIKI, VUJE, NRI), also involving the EREC experts.

The three new experiments (main steamline break, 200 mm and 90 mm pipe break) were conducted in summer, 2002. Since one of the objectives of the experiments was to validate the computer codes performing the modelling of the containment and the bubble condenser, the experimental results were processed with different codes in the different institutes.

The post-test calculation results of the new experiments confirmed that none of the examined scenarios cause a higher load on the bubbler trays than the design value, and the value of the hermetic zone pressure remains far beyond the design pressure of the containment. The phenomenon of condensation oscillation was not experienced. The results show that the CONTAIN code adequately models the pressure and temperature of the hermetic zone during different accident scenarios.

An international consultation was held on this topic in February, 2002 in Budapest, in which representatives of the involved states (the Czech Republic, Hungary and Slovakia) participated, from both regulatory and plant sides. During the consultation the research institutes presented the results of the experiments and analyses. Subsequent to the presentations the regulators of the three countries unanimously agreed to accept the result of the research related to the bubble condensers and they regarded the examinations as closed. The decision was also supported by the representative of the OECD NEA Bubbler Condenser Steering Group. In due course, the HAEA NSD informed Paks NPP Ltd. of its standpoint in the decision.

At the request of the Authority, in recent years, containment integrity tests were also performed at pressures exceeding 120 kPa specified for the pressure tests after refuelling. In the period 1994 to 1997, tests were accomplished with elevated pressure (170 kPa) each year on another unit. On the basis of the results and the updated leakage characteristics the Authority and the Licensee negotiated on technical measures. As a result, besides the annual tests, an additional pressure test at 170 kPa is to be performed every four years on each unit. Moreover, preparations have been started to perform a single pressure test at the full design pressure of 250 kPa.

Annex 4

Manufacture, acceptance, installation, and testing of technological equipment

The Preliminary Safety Analysis Report contains detailed technical data of the 28 nuclear power plant components of distinct importance. It also features the technical requirements of manufacture, quality assurance, characteristics, manufacturing tolerances; the conditions of transportation, storage and conservation; the requirements of acceptance inspection and super-inspection and the non-conformances revealed by these; the requirements, accomplishment and non-conformances of installation; and the manufacture and delivery documentation. It lays down the consequences of non-conformance in all cases. This is followed by a description of 37 systems of distinct importance, and 7 additional systems. Finally, it deals with the quality assurance of the fuel.

Start-up, commissioning acceptance tests and the commissioning program

Commissioning plans laid down the objective, prerequisites, implementation, completion criteria, documentation and licensing requirements of certain steps. After the work was completed, all evaluations and statements had to be attached to the documents. Tests and commissioning took place in the following major stages:

- commissioning of the fresh fuel storage and the technological transportation system;
- commissioning of electrical components and systems;
- commissioning of control system equipment and radiation protection systems that directly serve the technology;
- cleaning of technological systems (primary, secondary, and ventilation systems);
- operational testing of technological systems;
- pressure test and circulation washing of the primary circuit, along with functional tests scheduled for this phase;
- start-up tests on the secondary side using auxiliary-steam taken from the temporary boiler for the first unit and from the operating unit in the case of consecutive units;
- the first revision, which included the dismantling and inspection of the reactor, the steam generators and other primary circuit components; the inspection of the cleanliness of the equipment after the pressure tests and circulation washing; installation practices for the maintenance staff under inactive circumstances;
- low-power test of the primary circuit;
- the second revision: status inspection requiring repeated dismantling;
- the integral pressure test, tightness test and the exact assessment of leakage values - with a comparison of these with the limit value for the hermetic zone including the primary circuit;
- physical start-up;

- the first connection of the given unit to the grid, followed by the tests of power start-up at different power levels: loading of the reactor up to around 20, 35 and 55% of its rated capacity, followed by the shutdown of the unit for scheduled preventive maintenance; further loading of up to 75% of rated power, then to 100%; and finally a 72-hour complex testing of the unit in its rated operational state;
- guarantee performance tests and certifying the unit as operational equipment.

Annex 5

Maintenance

The maintenance of the power plant aims to ensure 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 emphasis on prevention rather than repair. The basic objective is to carry out all maintenance activities (the overhaul of equipment, periodic maintenance with the units in operation, and so-called service-road maintenance that is carried out regularly through a maintenance review) in a well-planned, scheduled and regular manner.

General overhauls consist of the following activities:
- technical and safety reviews;
- periodic maintenance work;
- work prescribed by the authorities;
- repairing failures occurring during operation;
- safety upgrading measures, modifications, reconstructions.

Periodic maintenance work performed with the units in operation is accomplished on equipment, which bears sufficient reserves and thus can be handed over during the rated operation of the given unit. This reduces the work done at overhauls.

Regular maintenance reviewing serves for assessing the condition of operating equipment or that in stand-by mode. Maintenance of equipment is scheduled on the basis of such assessments.

Preparation is a key element of maintenance. Preparation is aimed at creating a database of the planned phases of continuous activities repeated periodically, and to establish optimal maintenance cycle periods in order to prevent unjustified over-maintenance.

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.

The essence of the overhaul strategy is the introduction of three basic types of overhaul. These types and the related principles of implementation are as follows:

- major overhauls performed every 4 years;
  - modifications of larger scale, reconstruction work; the revision of main components in line with long term schedules should be performed at this time;
- medium overhauls:
  - feasible technical and safety reviews, pre-assembly work related to larger modifications and reconstructions, certain modifications and work of periodic maintenance should be performed at this time;
  - it is advisable to define a maximum time period, which must not be exceeded when defining the time period taken; if the time period needs to be modified, then this is to be approved by the Maintenance Working Committee if the organization applying for such a permission provides sufficient justification;
- small overhauls:
  - only such work can be scheduled for this overhaul whose completion time does not affect the critical path (the reactor line).
  - the time taken depends on the shortest time necessary for the following process: shutdown, reactor dismantling, refuelling, reactor assembly, restarting

The order of executing maintenance activities

Maintenance activities in the nuclear power plant are regulated in a comprehensive manner in the Maintenance Quality Assurance Standard and the instruction of the Director General entitled "The Order of the Accomplishment of Maintenance, Reconstruction and Investment Activities". These documents include:

- the systems and components in question and their parts thereof;
- the activities to be performed;
- materials used directly or indirectly during the activities.

Corresponding to the maintenance, the quality control activities are performed in accordance with the regulating documents of the main processes of Quality Inspection and Safety. The system of requirements ensures that all activities related to the civil, electrical, instrumentation and control and mechanical engineering maintenance of the power plant are of adequate quality. Several kinds of supervising methods and regulation guarantee were introduced at Paks NPP.

Compliance with the quality requirements is inspected during maintenance supervision and quality control activities, in some cases the HAEA NSD staff.

The basic document of maintenance works is the work instructions. The work instructions ensure the normal, well-organized work of organizations taking part in the maintenance, and their efficient co-operation.

The Overhaul Scheduling and Implementation Order includes all tasks related to documentation and the names of the personnel responsible. The management body of overhaul scheduling is the Overhaul Planning Conference. The operation of this is regulated by conference rules. The implementation of the overhaul is determined by the overhaul authorization plan, the overhaul net diagram, and other instructions 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 outside contractors in maintenance is also regulated in detail. Two basic methods for commissioning contractors are used in the power plant: the first is by adding the outside experts to the corresponding team of the power plant on a temporary and task-oriented basis, and the other is by giving them individual tasks to be accomplished. In the first instance, the management of the experts is governed by the procedures established for regular employees of the power plant. In the second case, the factors ensuring supervised work are: the contract, the authorization of the employed technology, the system of work instructions, the hand-over of the working area, and the obligatory inspection exercised by the executives of the given professional area. The proportion of contractors hired of the latter type has risen during recent years.

Annex 6

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 prescriptions and requirements; compliance with its actions - in harmony with international practice, assessment of the problems based on their 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 the voluntary and independent revealing, reporting, and correction of any possible deviations from the prescriptions. The HAEA`s enforcement activities relate to those cases not following this approach.
- 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 avoidance activities
- Enforcement measures are necessary only on ascertaining the infringement of the prescriptions when without them compliance with the prescriptions could not be achieved, or would be subject to delay, or the severity of the occurrences demands express sanctions to prevent any recurrence.
- When the urgency and severity of the regulatory enforcement actions are ascertained, at first the direct impact of the prescription-infringements on safety are assessed, and secondly their potential future impact on safety shall be assessed.

Implementation of the enforcement policy is regulated by a procedural document. The procedure relies on the general rules of public administration procedures. The procedural document also addresses the situation when the violation of more prescriptions exists; when are they 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 prescription breached. Before its introduction in October 2002 the opinion of Paks Nuclear Power Plant Ltd., as the largest licensee, was sought in connection with the elaborated procedure.

The enforcement administration procedure was initiated in the case of three infringements of acts, 24 infringements of safety regulations, and 1 infringement of a legally binding, public administration regulatory decision. The HAEA NSD has not assessed two infringements of safety regulations as animously proven, therefore it closed the procedure without censure. It took no further action concerning the situation of one infringement of the prescription of the Act, and 17 infringements of the nuclear safety regulations because the conditions determining the reason for proceeding with the public administration procedure ceased, consequently it terminated the procedure. In the case of the remaining prescriptions (two relating to the Act, five relating to safety regulations, and one relating to a legally binding, public administration regulatory decision) the infringements were proven and, based on that, a fine of HUF 5 million was imposed on Paks Nuclear Power Plant Ltd. The company paid the fine, but appealed against the decision referring to there being no infringements of law in connection with the incident since the laws and regulations referred to by the Authority relate to systems of normal operation and do not relate to the eventually applied cleaning system.

Annex 7

Serious incident at Paks NPP on 10 April 2003

Introduction

A serious incident occurred at Paks Nuclear Power Plant on 10 April 2003 during the chemical cleaning of fuel assemblies. Even though the incident occurred outside Unit 2 it caused severe economic damage because of the long-lasting outage of the unit. Moreover, it involves severe long-term effects on the activities of both the plant and the Hungarian Atomic Energy Authority who supervises the plant's nuclear safety. The series of necessary activities and measures involve:

- providing a solution for the safe removal of the fuel damaged as a consequence of the incident that occurred in the revision shaft of Unit 2;
- dealing with the damaged fuel in such a way that it can be safely stored;
- restoring the operability of Unit 2;
- improving the safety culture at Paks NPP;
- providing a critical overview of the activities of the organizational units of the HAEA. This item relates to the legal background, to the human resources, and to the methods and procedures for licensing and inspection.

These activities were not terminated in 2003; they are being continued in 2004.

Apart from the unambiguous recognition of the severity and significance of its consequences it is also reasonable to point out that the incident did not take place within the technological systems necessary for the normal service of the plant, but it occurred inside a cleaning tank designed and operated by a foreign firm, FRAMATOME ANP in which the cleaning of fuel assemblies was being carried out during the overhaul of Unit 2. In view of this, the lessons learnt from the incident have in no way changed the evaluation of the nuclear safety of the plant, as a technological installation.

The following sections are aimed at providing insight into the magnitude of the task, and how the incident was and should be managed, and how to terminate its consequences. Hopefully, it is also clear from the report how much effort was and is being made by Paks NPP Ltd and the HAEA to reveal and eliminate the existing failures and to improve their workflow.

This annex describes the preliminaries, course, reasons and consequences of the incident, and also the directions of improvement measures based on the investigation report of the HAEA, on the independent review of the International Atomic Energy Agency, on the action plans of Paks NPP Ltd, and the HAEA, and on the technical and administrative measures that have already been implemented or whose implementation is under way.

The incident

Preliminaries

The deposits

The accumulation of corrosion products deposited within the primary circuit of Unit 2 of Paks NPP was first experienced in 1997. These deposits decrease the mass flow of the coolant and the heat transfer inside the fuel assemblies. In 1998 the operator had to shut down the unit in the middle of a campaign and the fuel assemblies had to be replaced. Investigations into the cause and the provision of an unambiguous analysis of the depositions are still being continued; however, it is known in the case of Units 1-3 that magnetite deposition is closely linked with decontamination (removal of radioactive contamination). Decontamination of steam generators was first performed at Unit 2 in 1996 and was carried out to an increased extent in 2000-2001 on Units 1-3 when the long delayed replacement of the jammed steam generator collectors became urgent.

The emission of corrosion products from the steam generators is unavoidable and it is taken into account in the design of all NPPs. In normal conditions it is dealt with by filtering the primary coolant and by regular changes of the fuel. In 2000-2001 during the extensive decontamination of the steam generators of Units 1-3, the last step, passivation was probably not sufficiently effective. Magnetite production suddenly increased causing an imbalance between magnetite production and filtration, magnetite deposits in the fuel assemblies increased and the cooling water flow-rate decreased. Consequently, the power of Units 1-3 had to be decreased; later, full refuelling became necessary in Unit 3.

In order to remove the depositions Paks NPP Ltd commissioned Siemens KWU with the chemical cleaning of 170 assemblies that had earlier been burned-up partially and subsequently removed from Unit 2. In 2000 and 2001 cleaning took place using a standard technology (having good references) and in a vessel containing 7 assemblies at one time. In 2002 Paks NPP Ltd commissioned FANP, the legal successor of Siemens KWU, to develop a vessel for 30 assemblies together with the associated cleaning technology.

The cleaning technology

The 7-assembly cleaning technology was considered by the Authority as a modification of a spent fuel handling system. In the safety classification of nuclear equipment systems (ABOS), the technology was assigned to ABOS Class 3 similar to the NPP`s other fuel assembly handling and transporting equipment. According to the Nuclear Safety Regulations (NSR), for equipment having an ABOS 3 classification only one licence is required: the modification license as prescribed in 1.§ a) of Govt. decree 108/1997. (VI. 25.) Korm. Licenses issued by the internal independent unit of the Licensee are needed for production, import, or installation. There was no need to license the operation of the equipment since the cleaning was to be carried out only once, after which the equipment was to be dismantled. Thus, licensing in accordance with the relevant regulation meant the execution of a process of modification licensing “in principle”.

According to the licence application, the 30-assembly system deviates from the previous one only in the capacity of the vessel, and it was modified to be capable of handling assemblies having significant decay heat. Because of the late submission of the documents, the evaluation of the application took place under time pressure. Even so, the application was examined and evaluated in accordance with the relevant regulations and internal orders by the HAEA Nuclear Safety Directorate. The effects of the chemical process were emphasized in the application, in the safety measures, in the emergency measures, and during the licensing process.

According to the safety analysis prepared by the designer and submitted with the application, the chemical cleaning technology can be applied with the necessary safety margin, the subcriticality of the assemblies in the cleaning vessel is ensured, the cooling is sufficient, the disposal of the radioactive waste produced can be solved.

The Authority reviewed the safety analysis and concluded that the subcriticality of the assemblies in the cleaning vessel was ensured, the cooling was sufficient during cleaning (mode C) and during the loading/unloading of the assemblies (mode A), as well as during the temporary stages (mode B) of opening/closing of the vessel lid. The measures planned for incident prevention were investigated and evaluated in the course of the licensing process. The correctness of the classification to ABOS-3 of the technology was confirmed for the 30-assembly vessel by the Authority.

Timetable

The sequence of events and the actions taken are summarized in the table below. Times or durations are given in the first column, the second column comprises a description of the event and the characteristic data.

Time	Event
10 April, Thursday	
16:00	Cleaning of the 6th set of assemblies (30 in number) is completed at Unit 2 but the assemblies could not be unloaded since the crane used for lifting the lid of the vessel had earlier been moved to assist cleaning of internal elements of the reactor of Unit 2.
16:40	AMDA (Automatic Mobile Decontaminating Assembly) is switched to mode B, the assemblies in the vessel are cooled with a D003 submersible pump by circulating the water of the revision shaft containing the cleaning vessel.
19:19–19:20	Slow increase in the water level of the pressurizer of Unit 2.
21:50	Sudden increase in the count-rate of the Kr-85 detector of AMDA.
21:53	Warning signal on the noble gas detector located on the reactor platform of Unit 2; the measured value is 1700 kBq/m^3.
22:02	The dose rate is 2 mSv/h at the volume compensator tank of AMDA, and 50 μSv/h at the noble gas outlet. FRAMATOME personnel explain it by fuel rod leakage.
22:17	Noble gas concentration is 18,300 kBq/m^3 on the reactor platform of Unit 2.
22:30	The dose rate is 20 mSv/h at the volume compensator tank. Up to this time 3 noble gas outbursts with an accumulated Kr-85 count number of 100,000 were detected.
22:50	Reactor hall is evacuated by order of the dosimetry leader on duty.

Time	Event
23:00	Noble gas emission increases to 6*105 MBq/m3.
23:30	The engineer on duty calls a special meeting of the Maintenance Working Group for 01:00 on 11 April.
23:45	The engineer on duty orders the ventilation of the reactor hall to be switched to full capacity.
23:55	Noble gas releases further increased, the current value is 1,5 TBq/m^3**.**
11 April, Friday	
01:55	End of meeting of Maintenance Working Group, having reached the decisions: - to lift the lid of the cleaning vessel - to try to visually identify the leaking assembly/assemblies - to prepare for transfer of the leaking assembly/assemblies to the spent fuel pool - to unload assemblies from the cleaning vessel after completion of the cleaning of the reactor and continue the cleaning programme**.**
02:15	Immediately after opening the hydraulic lock of the cleaning vessel lid the dose rate increased significantly (6-12 mSv/h) in the vicinity of the spent fuel pool and the vicinity of the revision shaft. Increase in the release via the stack. Water level in the spent fuel pool decreases in a short time by about 7 cm.
02:21	Water sample taken from the spent fuel pool indicates leakage of fuel assembly/assemblies.
04:20	Unsuccessful attempt to lift the cleaning vessel lid, one of the lifting cables breaks.
06:30	The dose rate in the middle of the surface of the revision shaft is 60 mSv/h, at the edge close to the platform stairs it is 30 mSv/h, close to the spent fuel pool it is 15 mSv/h.
07:45	Radioiodine release accumulates to 142.6 GBq. [1]
09:00	Maintenance Working Group meeting. Actions to be taken: - check position of vessel lid; - compile dosimetry trends; - analyse water samples radio-chemically.
09:00	The dose rate in the middle of the surface of the revision shaft is 30 mSv/h; 15 mSv/h towards the platform stairs; 0.8 mSv/h towards the spent fuel pool.
12:40	Director of Safety orders partial alerting of Emergency Response Organization (communication and radiological evaluation).
13:15	Engineer on duty introduces measures regarding ventilation through the reactor hall to decrease the release.
16:00	Investigation concludes that the vessel lid became stuck leaving a gap of about 15 cm on one side and about 2 cm on the other side. Outflow of warm water from the gap is found.
20:00	Further measures introduced by the engineer on duty to decrease the release.
20:20	Radioiodine release in the last 4.5 hours is 38.1 GBq, the effects of interventions aimed at decreasing the release introduced at 14:00 are clearly seen.
24:00	Daily noble gas release is 160 TBq. Radioiodine emission in the last 3.7 hours is 3.9 GBq, the effects of release decreasing interventions are clearly seen.
13 April, Sunday	
16:00	Director of Safety terminates the partial operation of the Emergency Response Organization.
14 April, Monday	

Time	Event
afternoon	Ammonia and hydrazine are added to the water of the spent fuel pool to enhance filtering the iodine from the water.
16 April, Wednesday	
16:23	Lid of cleaning vessel is lifted, no increase in release.
20:00	By visual (video camera) inspection, serious damage of the assemblies in the cleaning vessel is found.
22:30	Potential emergency (ALERT) is declared by Paks NPP Ltd, the Emergency Response Organization is activated.
17 April, Thursday	
07:30	Maintenance Working Group meeting Actions to be taken: - preparation of neutron flux and temperature measurements to ensure conditions for controlling subcriticality, - ensuring cooling of the damaged assemblies: mounting new pumps, monitoring of conditions for the operating pumps, - decrease of environmental releases: covering of the revision shaft and insertion of iodine filters into the suction-branch of the reactor hall ventilation.
18 April, Friday	
-	Neutron flux and temperature monitors and an observation camera are mounted in the vicinity of the cleaning vessel to monitor the subcriticality and the cooling of the fuel, as well as to monitor the conditions of the vessel.
19 April, Saturday	
-	Boric acid concentration in the spent fuel pool is increased to 16 g/kg to ensure subcriticality. Cooling pump of the cleaning vessel is changed for two new pumps with higher reliability. One pump is in operation, the other is a reserve that starts automatically if necessary. A plastic tent covers the revision shaft housing the cleaning vessel. Air is emitted from the tent through the operational ventilation system via filters.
20 April, Sunday	
09:00	The Director of Safety terminates the operation of the Emergency Response Organization.
-	Release falls below the limits derived for one day form the limit given in the technical specifications.

Causes

A thermal dynamics and flow dynamics model taking into account every possible condition may well be able to determine the immediate causes of the event. The use of such a model became necessary since it was clear from the very beginning of the investigation that though the engineering considerations based on energy balance applied in the design proved to be basically correct, they did not reveal the failures carrying the potential danger.

Furthermore, it was obvious at the final stage that the fuel assemblies were overheated due to the residual heat of the partially burned-up fuel elements. In physical terms, this could happen only if the flow of cooling water along the fuel stopped and the assemblies were not covered with water. Such developments may arise in two ways:

- a significant quantity of air penetrated into the vessel;

- the production of gas took place.

Penetration of air was first assumed by the investigating committee of the HAEA NSD but the information gained during the collection of data made this seem highly unlikely. Meanwhile the experts of HAEA NSD worked out a model of the internal conditions of the cleaning vessel with the help of the available thermal-dynamics and flow dynamics models.

After more attempts and theoretical considerations, the model was completed in appropriate detail It could then be shown that during the long-lasting existence of the so-called “B” mode the coolant flow through the assemblies was continuously decreasing, while the bypass of the assemblies was increasing at the same rate through the bore-holes on the assemblies and due to the inaccurate adjustment of the assemblies. The decreasing flow entailed increasing temperature. The changing rate of the flow pattern is dependent on the decay power of the assemblies, on the delivery height of the circulating pump, and on the number of bore-holes on the assemblies.

Data relating to the incident showed that boiling of the cooling water commenced after 2 hours and 10 minutes. This result coincides with the actual value reconstructed the incident. According to the model, about 1 hour after the start of boiling a steam bubble of such dimensions develops that a significant number of the assemblies are left without direct cooling. At that time the temperature of the assemblies increases by about 16 °C/min if no heat removal is assumed. In reality, there existed slight heat removal, partly via the so-called de-aeration tube and partly through the double walls of the vessel; however the model that was utilized was unsuitable for determining the resultant maximum heat removal. Based on the video camera inspection between June and September, 2003 it is obvious that such overheating of the fuel assemblies took place, as a result of which the fuel cladding ballooned and became significantly oxidized. Consequently a several fuel assemblies started to leak 22:00 hours. The severe damage to the assemblies was, most probably, caused by the sudden inflow of cold water when the vessel lid was opened and by the explosive production of steam.

To summarize: the direct cause of the incident, judging from the reconstruction, was that in addition to the delivery height of the pump in mode “B” and the geometrical shape of the vessel (outlet at the bottom), bypass flow developed through the bore-holes of the assemblies and the gaps existing due to poor adjustment of the assemblies. As a consequence, the flow through the fuel assemblies decreased and the decay heat of the fuel overheated the assemblies.

The presence of the bore-holes cannot be regarded as the root-cause, since it was an initial condition. Basic technical causes can be found in the design and mode of operation of the vessel. Based on the findings of the investigation and on the licensing documents, the following non-compliances may well have played a role in the development of the events:

- the design fault in the bottom location of the outlet of the inner vessel,
- the neglecting of the bore-holes during design and during design analyses,
- small cross-sectional area of the de-aeration tube,
- long-term operation in mode "B",
- neglecting early opening of the vessel lid,
- imprecise positioning of the bottom end of the assemblies (potential),

- lack of instrumentation, mainly lack of in-vessel temperature measurement, of the cleaning vessel,
- lack of continuous data acquisition (continuous data acquisition would have led to earlier failure detection),
- lack of analysis of the difference between the outlet water temperature and the near-surface pool water temperature,
- there was only a rough measurement of the pool water level, and nobody took those data into account.

The order of the events mentioned above reflects a certain order of importance. Location of the outlet at the top of the inner vessel would alone have prevented all the subsequent problems. Assuming that the outlet had been located at the top of the inner vessel, it follows that the cooling water is led out from the hottest point, therefore simple heat balance analyses would have been satisfactory for determining whether there is adequate cooling. Two other aspects of the main basic causes are worth a closer look: If the presence of the bore-holes had been taken into consideration, a properly detailed hydraulic analysis would have revealed that the cooling of the assemblies was inadequate and that a warming up process with positive feed-back would commence.

Evolution of the above technical conditions leading to the incident was enhanced by several human factors. The most important of these are: in recent years at the plant, a number of small signs the deterioration of safety culture could be observed; the production was outstanding, but production interests gradually prevailed over safety. The management of the plant and the licensing authority placed too much reliance on the high prestige contractor.

During the licensing, the need for effective cleaning and the adequacy of the chemical processes were emphasized but subsequently the importance of the cleaning process was under-estimated by both the plant and the authority.

Consequences

<u>Fuel damage</u>

The extent of fuel damage could be estimated based on the video records made after the opening of the vessel lid. Based on the description prepared by Paks NPP and on the processes that had taken place before and after the opening it is probable that the thermal shock of the penetrating cold water and the explosive steam production caused the severe damage to the assemblies. Due to this the parts beneath the support plate were seriously damaged, and the assembly heads moved upwards - and in some cases broke. Later, taking nuclear safety into consideration, based on specific programmes the HAEA NSD licensed internal video camera inspection. The basic objective of internal examination was to find out the extent of damage and to determine the volumetric pattern of the damaged fuel in order to specify the subcriticality calculation models. Four different camera positions were adopted for the inspections: the first three positions were located between the internal wall and outer assemblies, the fourth position was in the middle, empty position. Two cameras were used: one being a colour-film scanning camera (which remained above the vessel all the time), the other was a black–and-white pipe camera, which was inserted into the given position. During the filming, first it was surveyed how deep it could safely be inserted with optics facing downwards; then to as great a depth as possible the assemblies were scanned at 10 different heights at 10 cm intervals with a side-facing camera. During the inspections at some assembly positions the route was free down to the fuel-free part of the assembly.

The condition of the assemblies at the outer positions showed a similar picture beneath the support plate as above it. It was observable that the continuity of the assembly cladding was damaged at several assemblies, the fuel elements broke transversely between the upper and bottom parts. At the neck part of the upper plate the assemblies were swollen, completely filling the gaps of originally a few millimeters between the hexagonal holes and the assemblies. At many locations the elements were ballooning, in certain assemblies they completely touched each other, which meant a 3 mm increase in diameter. Both on the assembly walls and on the fuel element cladding, there were signs of considerable oxidation. Generally speaking, it could be stated that the claddings of all inspected assemblies were heavily damaged, and different colouring could be observed at the different cladding parts because of the different temperatures. It was apparent from the broken pieces of zirconium that the damage was glass-like brittle fracture; no bent pieces of cladding were found, which also indicates strong oxidation. The extent of cladding damage varied from assembly to assembly; the bottom parts of the assemblies up to different heights seemed intact. At the bottom of the vessel, the depth of the debris of rod pieces that had dropped down was about 5-60 cm; at the bottom fuel pellets could also be found that had dropped down. At one location the surface of the bottom plate could also be seen.

At the central, empty position the inspection could cover only a relatively short distance since 30 cm below the upper plate a piece of rod had prevented further penetration. One third of the assemblies located at that part of the vessel were completely damaged; cladding and rod pieces could be found 50 cm below the plate. The bottom parts of the assemblies could be seen beneath these, thereby confirming that the structure of the bottom parts of the assemblies remained intact, there was less damage there. Some parts of the assemblies located at the internal part of the vessel were destroyed; other parts at least partially kept their original structure; however, the cladding was broken and detached.

Based on the inspection it can be stated that all fuel assemblies were damaged, there is no assembly that can be regarded as intact. The extent of damage is dependent on the location, the heaviest damage can be observed at the central assemblies. The assemblies partially kept their shape, though their dimensions changed to some extent. From the neutron-physics point of view the overall damage is favourable, since the shape of the nuclear fuel similar to the original structure, which is important with regard to maintaining subcriticality. The picture that was provided by the visual inspections supported the previously calculated and measured situation that the system is deeply subcritical, and it is under control so far as neutron-physics is concerned.

Environmental impact

According to preliminary data 410 TBq noble gases, 360 TBq radioiodine, and 2.5 GBq radioaerosols were released into the environment in the first two weeks of the incident. One half of the noble gases, predominantly Xe-133 and Kr-85m, and most (95%) of the activity of the radioiodines (expressed in I-131 equivalent), was released in the first day. The time distribution of the radioaerosol release was similar to that of the radioiodines, though the quantities were much lower.

In the first hours of the incident the environmental impacts of the noble gas plume were detected by the telemetric environmental monitoring station A1 located 2000 m north of the stack (downwind direction). Later, no dose rate increase attributable to the incident could be detected by any of the telemetric monitoring stations.

From the morning of 11 April onwards, the Environmental Laboratory of the plant monitored daily the area of the NPP and its vicinity. Reliable information was gained on the small values of deposition by comparing the data obtained by various methods.

Measurements made by modern mobile dose rate meters supplemented the data of the telemetric stations. The surroundings of the plant were painstakingly and comprehensively monitored by the NPP staff. Results of the daily measurements were recorded.

The maximum individual dose for the most exposed members of the population was found to be 0.13 μSv as obtained by model calculations based on measured radiological and meteorological data. This value is equivalent to about 1 hour dose from natural background radiation.

On 14 April, the Director General of the HAEA initiated a co-ordinated environmental monitoring program with the participation of the leading laboratories (laboratories of the Ministry of Agriculture and Rural Development, National Research Institute for Radiobiology and Radiohygiene, State Public Health and Medical Officers' Services, Directorate General National Emergency Management of the Ministry of Interior, KFKI Atomic Energy Research Institute, National Meteorological Service). The main objective of the programme was to collect and disseminate detailed data in order to provide reliable information to the public. These results may later be utilized to verify the atmospheric and dosimetry models utilized to help in decision-making in nuclear emergencies.

The Regulatory Environmental Radiation Protection Monitoring System, in the framework of which the institutes and regional laboratories of the competent ministries, the Ministry of Health, Social and Family Affairs, the Ministry of Agriculture and Rural Development, the Ministry of Environmental Protection and Water Management, perform harmonized measurements and monitoring within a circle of 30 km radius around the NPP. It could be seen in the evaluation of the data of 2003 that compared to the previous years there was no increase in the radioactivity of environmental elements except for the radioiodine concentration in a short period after the April incident of the Paks NPP. With regard to the incidental release and its environmental and public impacts a separate report was prepared by the institutes participating in the system. The most important statements of that report are as follows:

- the airborne incident releases, specifically strontium and iodine, exceeded the 30-day limit in the common stack of Units 1 and 2, by 4 times and 13 times respectively (other components of the release were below the limits);
- the effluent releases did not exceed the time proportional limits;
- except in the direct vicinity, i.e. the area of the operational monitoring system, of the plant the impact of the releases was detectable only in a small part of the samples (as maximum the detection limits of radio-iodine were exceeded a few times in some aerosol and grass samples);
- the maximum value of public radiation exposure did not exceed the value of 140 nSv (the dose limit of the population related to the plant releases is 90 μSv).

Reports

Comprehensive investigations were initiated concerning the serious incident of 10 April at Paks Nuclear Power Plant. Paks NPP Ltd investigated the event as prescribed. The HAEA NSD set up an individual investigation team which immediately started its on-the-scene investigation. As part of the investigation the Authority interviewed all important participants of the incident. The Director General of the HAEA established an independent investigation team in relation to the inspection and licensing activities of the HAEA NSD concerning the incident. Furthermore, at the proposal of the Director General of the HAEA, the chair of the HAEC, the Minister of Economy, on behalf of the government invited the International Atomic Energy Agency to conduct an independent international expert mission to investigate the event.

The following reports were prepared on the investigations and reviews performed in connection with the incident:

- Report of Paks NPP Ltd to the HAEA NSD on the fuel damage that occurred on 10-11 April 2003, in the cleaning tank designed, manufactured and operated by the FANP.
- Report of the HAEA to the Hungarian Atomic Energy Commission on the regulatory investigation of the incident of 10 April 2003.
- Summary report concerning the incident of 10 April 2003 on the examinations performed by the Health and Radiological Measurement and Data Management Network of the State Public Health and Medical Officer Service.
- Report on the expert mission of the International Atomic Energy Agency held in order to evaluate the investigation results of the Hungarian Atomic Energy Authority conducted in connection with the serious incident that occurred on 10 April 2003 at Paks Nuclear Power Plant.
- Report of the Regulatory Environmental Radiation Protection Monitoring System on the environmental impacts of the incident at e Paks Nuclear Power Plant.

All reports can be downloaded without restriction from the websites of the Paks Nuclear Power Plant, of the HAEA, and of the "Frédéric Joliot-Curie" National Research Institute for Radiobiology and Radiohygiene.

Incident management

The technical activities performed after the immediate steps were taken to deal with the incident can be divided into three main phases. Under the first, so-called stabilization phase the possibility of inspecting the condition and coolability of the damaged fuel and the minimization of the radioactive release had to be ensured. These rapid measures extended to the first month after the incident. In the second, so-called preparatory period, the conditions for long-term stability had to be established by means of the design and commissioning of technological modifications, administrative measures, and modification of operating procedures. Within this phase, the elaboration of the restoration concept, the tendering of bids and selection of the prospective contractors to carry out the restoration, the requirements for the restoration, signing of the contracts, elaboration of the licensing documentation all took place. The third phase will comprise the removal of the damaged fuel and the cleaning tank and the restoration of the revision shaft.

<u>Stabilization phase</u>

During the stabilization phase the following work was performed:

Based on the preliminary visual inspections Paks Nuclear Power Plant Ltd prepared a report on the state of the damaged fuel in the cleaning tank. The HAEA NSD, based on the enclosed video records, evaluated the report. The authority prescribed the performance of certain calculations to justify the subcriticality. The KFKI Atomic Energy Research Institute and the Institute of Nuclear Techniques of the Budapest University of Technology and Economics, based on the above-mentioned calculations, found that to make a conservative assumption (in the case of unfavourable though of low probability, arrangement of damaged fuel from the criticality viewpoint) for the reliable insurance of subcriticality a boric acid concentration of 19 g/kg was necessary. The HAEA NSD, in relation to the spent fuel pool and the revision shaft, prescribed that the boric acid concentration be increased and maintained at 20±1 g/kg, and that appropriate technical and administrative measures be implemented to prevent boron dilution. Beyond that the HAEA NSD issued a number of decisions concerning the control of subcriticality, the safe cooling and the inspection of cooling, the filtration of the coolant, the inspection of water chemistry and radiochemistry, filtration of the air, and the design and installation of the equipment needed for radiation monitoring and the related modifications.

For handling the activities connected with the damaged fuel, Paks NPP Ltd established an individual project. The main tasks of this Restoration Project are: elaboration of technical substantiation, implementation alternatives and decision proposals, maintaining contact with the authority and co-operating organizations, co-ordination of individual tasks. The Project - apart from dealing with the removal of the damaged fuel and the cleaning tank, restoring the original stable state and the separation from the other parts of the unit - formulated the objective of creating the prerequisites for the restarting of the unit. The HAEA NSD, based on the rules of operation and the quality assurance program of the Restoration Project, approved the consequent organizational changes of the Paks Nuclear Power Plant.

The chair of the Hungarian Atomic Energy Commission (the Minister of Economy and Transport) nominated a ministerial commissioner to supervise the restoration work. Agreement was established that the HAEA informs the commissioner of all its decisions that are related to the incident and its consequences.

Preparatory phase

The HAEA NSD, for the more efficient administration of the restoration of the revision shaft, established a separate team within its organization. The team leader, as an observer, participates in the steering committee meetings of the Restoration Project. The ministerial commissioner and the representatives of the KFKI Atomic Energy Research Institute and the Institute of Nuclear Techniques of the Budapest University of Technology and Economics are also permanent participants in the meetings.

Further calculations were performed to confirm the subcriticality of the damaged fuel in the cleaning tank. The HAEA NSD licensed the visual inspection program inside the tank, by which the Paks Nuclear Power Plant Ltd obtained detailed information on the state of the damaged fuel, and on the detailed geometrical arrangement of the damaged fuel rod pieces. Based on the prescription and licence of the authority the operator installed two additional neutron flux and temperature measurement systems next to the tank. Paks Nuclear Power Plant Ltd together with Hungarian designer institutes, elaborated three concept plans for the autonomous cooling of the revision shaft, as part of the restoration concept. The objective of establishing a new cooling system is to make the revision shaft separable from the spent fuel pool, thus making the technology of Unit 2 as independent as possible from the systems ensuring the storage, cooling, condition monitoring and inspection of the damaged fuel. The detailed design of the selected cooling technology, as part of the licensing documentation required by nuclear safety, was elaborated by the contractors of Paks Nuclear Power Plant Ltd, and it was then submitted to the HAEA NSD.

In possession of the HAEA NSD`s licence, FANP dismantled and removed the technological equipment used for the chemical cleaning of the fuel assemblies.

The HAEA NSD, bearing in mind the relevant prescriptions and international recommendations, elaborated and handed over to Paks Nuclear Power Plant Ltd the licensing requirement system for removing the damaged fuel.

Paks NPP Ltd announced the opening of bidding for the elaboration of the removal technology of the damaged fuel, and for carrying out the restoration work of the revision shaft. The bidders were FANP (mainly its German affiliated company with French and US expert support) and TVEL (the consortium invited by the Russian organization MINATOM with the involvement of other Russian institutes and firms). Evaluation of the bids took place in two phases, through one expert evaluator committee and one management evaluator committee. The evaluation criteria included technical feasibility, existence of references, the safety, the deadline and the cost. The successful bid was that of the Russian consortium. The strengths of the Russian bid were:

- direct motivation, as the supplier of the nuclear fuel of Paks Nuclear Power Plant;
- appropriate management of subcriticality (measurement and evaluation method and program were also included in the bid with the participation of the Kurchatov Institute);

- existence of the recommended storage tools for the damaged fuel (the Russians are both licensed and experienced);
- experience in the usage of manual tools during the handling of spent fuel assemblies;
- Russian governmental support;
- more favourable implementation deadlines;
- more favourable price.

The HAEA NSD prescribed a three-stage licensing process in the licensing requirement system. It determined the formal and content requirements related to the documentation to be submitted for all three stages. The first phase is the modification license in principal, to which the Russian party supplied the technical design documentation until the end of 2003. The internal expert panel of Paks Nuclear Power Plant Ltd started to consider the documents at the end of the year. The second stage involves the steps necessary for the issuance of the manufacturing and import licenses, the third relates to the modification license.

For the Hungarian registration of the licensing documentation and for ensuring the meeting of the Hungarian design requirements, in order to comply with the Hungarian standards, Paks Nuclear Power Plant Ltd, signed an agreement with the two companies the ERŐTERV Rt. and TRANSELEKTRO.
These companies accepted an outstanding role in the design and establishment of the supplementary technologies necessary for the separation and independence of the revision shaft.

The HAEA NSD issued modification licenses in relation to the existing technologies to ensure the separate cleaning of the coolant of the spent fuel pool and the revision shaft of Unit 2 without interfering with the technology of the other units; similarly, licences were issued to enable the boric acid concentration in the cleaning tank and the revision shaft to be increased in the case of hypothetical reactivity incidents.

The HAEA NSD prescribed that Paks NPP Ltd should submit a document describing the conditions and limitations of safe operation of the revision shaft. In due course, the document was submitted and was subsequently approved after the appropriate critical review and necessary modification

Paks Nuclear Power Plant, knowing the more detailed schedule of restoration and after due economic considerations but also taking the safety aspects into account examined the possibility of restarting and operating Unit 2 before the actual commencement of the restoration work. Bearing in mind that the April incident had not involved the technological systems of the unit, the critical conditions for restarting Unit 2 were specified as follows: ensuring the next fuel load of Unit 2; the possibility of safely manipulating the fuel; and the possibility of cleaning the structural elements of the reactor from alpha-emitter contamination. . The elaborated alternatives were submitted to the HAEA NSD. The plant initiated the authority to formulate its requirement system concerning the restarting of Unit 2. In order to elaborate the requirement system, and to oversee efficient execution of the licensing and inspection tasks the HAEA NSD established a small team of experts.

As a means of supporting the regulatory overseeing of the restoration work the HAEA NSD contacted the Russian and the US nuclear safety authorities. Detailed contracts were signed to gain outside expertise for dealing with certain parts of the licensing documentation, and, in the case of the Russian authority, for co-operation in the quality assurance audit of the companies those are members of the consortium.

Measures to improve efficiency

Based on the experience gained from the incident and as a result of the investigations several measures, recommendations, and suggestions were formulated to improve the operating and regulatory activities.

Paks Nuclear Power Plant Ltd

Paks Nuclear Power Plant Ltd, in order to implement the decision of the HAEA NSD, elaborated and submitted a Comprehensive Action Plan. The action plan contains 26 tasks with deadlines. In addition to the itemized task descriptions it cites the recommendations, suggestions and remarks as a background for the tasks, and for each item it describes those considerations that justify the necessity of the given measure. At the time of the closure date of the Annual Report the HAEA NSD was still reviewing the plan.

As a means of orientation for the Governing Board of Paks Nuclear Power Plant Ltd an organizational diagnosis of the plant was prepared. This diagnosis, by revising and organizing the various domestic and international reviews and the audit reports of the past ten years, and the serious incident related documents, sought for an answer as to how the Power Plant could arrive at the serious incident, what were the background reasons for the deficiencies of the safety culture, and what is the current state of the organization. Based on the organizational diagnosis, Paks Nuclear Power Plant elaborated its organizational and operational development concept. The concept primarily sees the possibility of bringing about a change in the attitude of the employees, which is intended to be implemented by operational improvement of the organizations and not by reorganization. The following were defined as success criteria concerning the organizational development:

1. ongoing commitment of high and middle level managers;
2. availability of resources;
3. direct direction and continuous control of the implementation of the concept by the NPP`s director general;
4. continuous, open communication, with active high- and middle- level manager participation;
5. decisions on short-term measures that can bring quick and fruitful results in advance of the long-term measures.

HAEA NSD

As a basis for increasing the efficiency of the HAEA NSD, the report of the independent assessment team designated by the Director General of the HAEA, the recommendations of the report of the expert mission of the International Atomic Energy Agency, and the critical self-assessment of the HAEA NSD were taken into consideration.

The tasks are divided into two groups: the short-term tasks are mainly aimed at improving the quality and efficiency of the links with the licensees (primarily with Paks Nuclear Power Plant); the long-term tasks concentrate on those of large volume involving modifications of their working processes.

Short-term tasks

The short-term tasks typically finished in 2003, within the framework of which the HAEA NSD performed the below most important tasks:

- it repeatedly declared that its most important viewpoint is that safety prevails over everything else, and it requested and obtained a similar declaration from the management and Governing Board of Paks Nuclear Power Plant Ltd, and from the management of the Hungarian Power Companies Ltd.
- it elaborated and described to the management of Paks NPP Ltd those principal and practical expectations concerning the license applications whose precise fulfilment is necessary to improve the efficiency and level of licensing;
- it formulated and harmonized with the management of the Paks NPP Ltd those strict conditions with which the out-of-turn licensing procedure can be justified;
- it determined and described to the management of Paks NPP Ltd those inspection and enforcement steps which are intended to apply in order to achieve homogeneous success of the regulatory decisions;
- it established the above-mentioned two working groups that are dealing with the removal of the damaged fuel from the revision shaft and with the energetic restarting of Unit 2 in order to provide concentrated performance of regulatory activity;
- it determined the tasks of over-riding importance to be performed in the upcoming years.

Long-term and comprehensive tasks

In order to carry out the longer term and comprehensive tasks the HAEA NSD prepared a plan containing the schedule and responsible individuals for the tasks. The implementation of most of the tasks is due to be completed in 2004 and 2005. One part of these tasks is directly related to the incident (sometimes to its direct consequence), the other part is to be performed independently of the incident; however, the consequences of the incident influences the method and content of its implementation. The following tasks (the list is not comprehensive are restricted to the most important elements:

- Fulfill the recommendations of the International Atomic Energy Agency`s expert mission: based on the recommendations of the expert mission the HAEA NSD determined 63 tasks, from which 23 require modification of the regulations, procedures and guidelines.
- Review of IAEA safety standards: the safety recommendations are compiled in a document system. The review of the documents was initiated, its objective is to reveal those recommendations and expectations which are missing from the Hungarian legislation (primarily from the Nuclear Safety Regulations).
- Review of the Nuclear Safety Regulations: its objective is to include the recommendations and expectations of the IAEA and modification recommendations derived from the incident.

- Taking part in the development of the recommendation system of the Western-European Nuclear Regulatory Association: The nuclear safety regulators of the EU member and joining states, based on the recommendations of the IAEA are developing a harmonized European safety recommendation system. The HAEA NSD experts are participating in this and, when the regulation system is developed, will co-ordinate its domestic introduction. .
- Critical self-assessment of the tasks, resources, organization and working methods of the HAEA NSD: after the wide-scope data acquisition, organization and analysis, and the summary of the incident-related regulatory experiences the management board of the HAEA NSD will accept proposals for introducing the modifications to the work and organization of the HAEA NSD. The changes will equally influence the internal and external (with the plant) share of work, and the working methods of the HAEA NSD (scope and relations of licensing, inspection and evaluation). The HAEA NSD will summarize the whole working material of the critical self-assessment in one document.

Preparation for the tasks of great importance facing the HAEA NSD: the upcoming years will inevitably bring several regulatory tasks requiring significant resources. The most important of these are: termination of the consequences of the incident;, restarting of Unit 2; power upgrading of the Paks Nuclear Power Plant units; preparation for extending the service life of the NPP; review of the Final Safety Analysis Report of the NPP; regulatory review of the level 2 probabilistic safety assessment of Paks Nuclear Power Plant.