REPUBLIC OF HUNGARY

NATIONAL REPORT

Fourth Report

prepared within the framework of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

2011

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Section A. Introduction

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (hereafter Convention) was promulgated by Act LXXVI of 2001 [I.11]. (Hereafter the references to legal instruments listed in Annex 4 are used by numbering in brackets.) In order to fulfil the obligations of Article 32 of the Convention the present National Report has been prepared and submitted.

Apart from this Introduction (Section A), this National Report contains ten more sections and eight annexes in accordance with the Guidelines regarding the Form and Structure of National Reports (INFCIRC/604/Rev.1).

Section B describes the general policies and practices in Hungary. Generation of radioactive waste started simultaneously with the introduction of isotope technology in Hungary in the early 1960’s. First, a low and intermediate level waste (LLW/ILW) storage was built. As the site proved to be inadequate for long-term disposal, it was closed and cleaned up, and a new site, which is still in operation, was commissioned in 1976.

After the commissioning of the four units of Paks Nuclear Power Plant between 1982 and 1987, spent fuel and an increased amount of waste have been generated.

A major part of the spent fuel of Paks Nuclear Power Plant was shipped back to the Soviet Union (later Russia) between 1989 and 1998. At present, a modular type interim spent fuel storage is in use and is being enlarged as necessary. The disposal of high level waste (HLW) is a long-term programme.

In 1993, Hungary launched a national programme to solve the problems of radioactive waste management. A suitable site was identified in granite host rock in the vicinity of Bátaapáti where a below-surface repository would be able to accommodate the LLW/ILW waste of Paks Nuclear Power Plant. *The surface facilities of the repository have been completed; the establishment of the first two underground chambers is in progress.*

In Section C on the scope of application it is declared that there are no reprocessing facilities in Hungary and no spent fuel originates from military applications.

The inventories of waste stored or disposed of in the existing facilities and rates of waste generation are given in Section D.

Section E describes the Hungarian legal background. The basic regulation in force at present, Act on Atomic Energy [I.6], expresses the national policy in the application of atomic energy. It regulates the various aspects of radioactive waste management. Among other items, this Act declares the priority of safety; defines the tasks of the national authorities; and prescribes the establishment of a Central Nuclear Financial Fund for financing the disposal of radioactive waste, the storage and disposal of spent fuel, and the decommissioning of nuclear facilities.

Other aspects of the safe management of spent fuel and radioactive waste, the responsibilities of the licensees and authorities, issues of emergency planning, international relations, and questions of decommissioning are discussed in Section F.

Sections G and H discuss in detail the problems related to the safety of spent fuel and ILW/LLW management, respectively. The Act on Atomic Energy [I.6] formulates the safety philosophy of all existing and planned activities by stating that:
"The interim storage and final disposal of radioactive waste and spent fuel shall be considered safe if

a) the protection of human health and the environment is ensured throughout the entire duration of these activities;
b) the impact on human health and the environment is not higher beyond the country borders than that accepted within the country."

Transboundary movement of radioactive waste, described in Section I, is regulated in accordance with the international rules.

In Hungary, in recent years a new unified computerised local and centralised accountancy system has been introduced that further strengthens and significantly enhances the efficiency of the management of spent radioactive sources, as described in Section J.

Section K gives a summary of the current and planned activities aimed at further improving the safety of waste management.

Sections B, D, E, F and K are arranged in such a way that the part related to spent fuel (in Section B together with the part related to high level waste) is followed by discussion regarding radioactive waste.

Technical details are given in Annexes 1-8. Annexes 1-3 describe the existing facilities for spent fuel and radioactive waste management as well as the isotope composition of radioactive waste. Annex 4 contains a list of Hungarian laws and regulations relevant to the scope of the Convention. In Annexes 5 and 6 reference is made to official national and international reports related to safety and to reports on review missions that have been performed at the request of Hungary. *Annex 7 deals with the remediation of the area of the closed uranium mine and post-remediation long term monitoring activity.* Annex 8 deals with the spent fuel management and releases of nuclear facilities other than spent fuel management facilities.

This *fourth* National Report prepared in the framework of the Convention is a stand-alone document, demonstrating the fulfilment of our obligations undertaken under the Convention. *The new developments, in comparison with the previous (i.e. the third) National Report, are typeset in Italics. Having taken into account the lessons learned from the third review conference, this report discusses in a more detailed way the strategic issues and the regulatory system, as well as financial and human resources.*

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The compilation of the report was finalized on 31 March 2011; the inventory data herein, unless otherwise indicated, described the conditions as of 31 December 2010.

Declaration

The Republic of Hungary declares that:

- *priority is given to the safety of spent fuel management as well as the safety of radioactive waste management, and both are achieved by way of legal regulation alongside the efforts of regulatory bodies and operators;*

- *appropriate measures are taken to ensure that, during all stages of spent fuel management and radioactive waste management, there are effective defences against potential hazards in accordance with the objectives of the Convention;*

- *appropriate measures are taken to prevent accidents with radiological consequences and further to mitigate the consequences of such accidents should they occur during any stage of spent fuel management or radioactive waste management.*

Budapest, May 2011

Dr. József Rónaky
Director General of the Hungarian Atomic Energy Authority

Section B. Policies and Practices

> ***ARTICLE 32. REPORTING***
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> *1. In accordance with the provisions of Article 30, each Contracting Party shall submit a national report to each review meeting of Contracting Parties. This report shall address the measures taken to implement each of the obligations of the Convention. For each Contracting Party the report shall also address its:*
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> *(i) spent fuel management policy;*
> *(ii) spent fuel management practices;*
> *(iii) radioactive waste management policy;*
> *(iv) radioactive waste management practices;*
> *(v) criteria used to define and categorize radioactive waste*

B.1 Spent nuclear fuel and high level waste

B.1.1 Practice

Since all the feasible scenarios of the fuel cycle back-end lead to disposal of HLW, the issues of HLW and spent nuclear fuel are discussed together.

Hungary has three nuclear facilities producing spent fuel: Paks Nuclear Power Plant, the Budapest Research Reactor operating at the campus of the KFKI Atomic Energy Research Institute (Budapest Research Reactor), and the Training Reactor of the Institute of Nuclear Techniques at Budapest University of Technology and Economics (Training Reactor).

HLW is generated during the operation of Paks Nuclear Power Plant and is temporarily stored in purpose-designed storage tubes (pits) at the plant. Inevitably, decommissioning of the power plant will also produce HLW in the future. The decommissioning of the other two nuclear facilities will also produce radioactive waste, but to a much smaller extent. These high level wastes can be disposed of together with the similar wastes of the nuclear power plant.

From the very beginning it was obvious that all the problems associated with the management of HLW would have to be solved by Hungary on its own, irrespective of whatever solution might be found for the issue of the fuel cycle back-end.

In 1995 a programme was launched as a means of solving the disposal of high level and long lived radioactive wastes. Although this programme outlined long-term ideas, it mainly focused on the in-situ site investigations carried out by the Mecsek Ore Mining Company with the help of the Canadian AECL in the area of the Boda Claystone Formation at 1100 m depth (accessible from the former uranium mine) during 1996-98. The programme was limited to three years because of the closure of the mine in 1998; the reason for this was that the existing infrastructure of the mine could be economically maintained only during this time period.

The studies were completed by the end of 1998 and summarised in a documented form. According to the final report there were no circumstances questioning the suitability of the Boda Claystone Formation for HLW disposal purpose. In 2001, in order to support the step-wise decision-making, a preparatory study was elaborated.

In line with the development of the strategy, the investigations of the Boda Claystone Formation aimed at its exploration and the selection of a suitable site have continued since 2004. The primary objective of the re-started research has been to select the location of an underground research laboratory. The preparations, however, have continued more slowly than expected because of the preferential importance of the National Radioactive Waste Repository for the final disposal of LLW/ILW of Paks Nuclear Power Plant, hence the schedule of the project aiming at selection of site for an underground research laboratory had to be revised.

At the beginning of 2008 a document entitled "Updated concept of the long term research programme of the Boda Claystone Formation including content, financial and schedule aspects" was prepared. On the level of a draft concept, the study discusses the possible extent, expected costs and scheduling of the preparatory research activities aimed at the domestic disposal of the high level waste and spent nuclear fuel.

The Swiss radioactive waste management organization (that being NAGRA) was asked for the professional evaluation of the study. The evaluation of NAGRA concluded that the step by step approach, applied during the development of the programme, is in compliance with the method followed world-wide by advanced national programmes. At the same time, NAGRA calls attention to the importance of the problem oriented approach that is supported by safety assessment, as well as to the establishment of a strong leader and manager group within the Public Limited Company for Radioactive Waste Management (PURAM, see Section F.2.2) in order to assure the harmonization, and successful accomplishment, of research activities. This group should be responsible for programme planning and strategic issues, as well as for integration of results coming from various fields of expertise.

The programme will inevitably need to be updated from time to time in the light of new knowledge.

The investigations have been supported by the adjacent nine municipalities.

Spent fuel from Paks NPP

A Hungarian-Soviet Inter-Governmental Agreement on Co-operation in the Construction and Operation of Paks Nuclear Power Plant was signed in 1966, and an Additional Protocol was added to it in 1994. In these agreements, still in force, the Russian party undertakes to accept delivery of the spent fuel and the Hungarian party undertakes to purchase the necessary new fuel assemblies exclusively from Russia for the whole life-time of the nuclear power plant. After having shipped back the spent fuel, until now Hungary did not have to take back the radioactive waste and other residuals from the reprocessing of such fuel.

The major part of the spent fuel was shipped back to the Soviet Union (later Russia) between 1989 and 1998. However, in the 1990's, contrary to the terms of the original agreement though in accordance with international practice, the responsible Russian authorities wished to have Hungary take back the residual radioactive waste and other by-products created during reprocessing. At present Hungary does not have the capability to dispose of high-level or long lived radioactive waste.

It was for these reasons that the licensing and construction of an interim spent fuel storage were started in 1993. Paks Nuclear Power Plant commissioned the British company GEC

Alsthom to build a dry storage facility of the MVDS (modular vault dry storage) type. One of the advantages of this type of construction and storage technology is that the number of storage modules can be increased in a modular system. *Currently, the first 16 modules completed up to the end of 2007 are available (each having a storage capacity of 450 fuel assemblies), the construction of modules 17-20 is in progress.* The facility for the interim storage of spent fuel allows for the storage of the assemblies for a period of 50 years. The site of the Interim Spent Fuel Storage Facility is in the immediate vicinity of Paks Nuclear Power Plant. It is situated at a distance of 5 km south of Paks.

Further details of the facility are given in Annex 1, its safety is dealt with in Section G.

Spent fuel from the Budapest Research Reactor and from the Training Reactor

Spent fuel arises mostly as a consequence of the operation of Paks Nuclear Power Plant. In addition the operation of the 10 MWth Budapest Research Reactor (10 MWth) , and that of the Training Reactor (100 kWth) a contribute to spent fuel generation.

The spent fuel of the Budapest Research Reactor can be and up to now has been temporarily stored in wet storage facilities. However, for long-term storage, dry storage in an inert gas atmosphere is more advantageous. Therefore, the operator of the Budapest Research Reactor, in agreement with the Hungarian Atomic Energy Authority, decided to modify the storage conditions. Based on the new concept, the fuel elements will be encapsulated and stored in a nitrogen atmosphere *Currently, after the repatriation of the spent fuel assemblies to the Russian Federation, the storage tank is empty (see B.1.2).*

The Training Reactor is operating with the fuel elements that were placed in the core at the start of the operation and after the reconstruction in 1980. The burning rate of the reactor fuel elements is slow as a result of the low maximum power and the carefully planned operation in connection with student training and research activities. Adequate fuel cladding condition was confirmed by analyses. Consequently, the reactor can operate for many years further without refuelling.

B.1.2 Policy

As a preparation for the disposal of the high level waste an underground research laboratory should be built in the above-mentioned Boda Claystone Formation. Should the results of the investigations be successful, the planned repository may well be able to serve for accommodating either directly the spent nuclear fuel or the residues resulting from the reprocessing of the irradiated fuel.

Spent fuel from Paks NPP

As yet, there is no decision on the back-end of the fuel cycle, but - in order to calculate the future costs of radioactive waste and spent fuel management, as well as to assure the necessary funding - some assumptions need to be made. As a reference scenario the postulation of direct disposal of the spent fuel assemblies in Hungary was accepted.

In the course of the elaboration of the strategy *for the closure of the fuel cycle* it is worth while to examine various possibilities, including the shipment of spent fuel abroad. In principle, this latter is a possible option due to the protocol on conditions concerning the reshipment to the Russian Federation of Russian-made spent fuel assemblies signed on 29 April 2004 by the Government of the Republic of Hungary and the Government of the Russian Federation. That future decision should be based on technical, economical, political, social considerations and also on achievable guarantees at intergovernmental level.

The document supporting the new programme regarding the treatment and management of radioactive waste and spent fuel was finalized by the beginning of 2010, which provides a comparison between several options regarding the closure of the fuel cycle, based on qualitative and quantitative aspects. A decision was made, based on analyses, that Hungary considers the direct disposal of the spent fuel as a reference scenario. This scenario is the basis for the budget plan justifying the financial contribution of the Paks NPP Ltd to the Central Nuclear Financial Fund (see F.2.2.2).

Spent fuel from the Budapest Research Reactor and from the Training Reactor

Advantageous changes have occurred with regard to the fuel elements of the Budapest Research Reactor since the completion of the previous National Report. The first step of the repatriation process to the Russian Federation initiated and financially supported by the US DOE was completed in 2008 in the frame of the IAEA RER/4/028 programme; every fuel used before 2005 was repatriated. Currently, the Budapest Research Reactor is in the phase of conversion to low enriched fuel elements; the core is filled with a mixture of low enriched (19.75% ^{235}U*) and high enriched (36%* ^{235}U*) fuel elements. The last high enriched fuel elements are expected to be removed from the core by the end of 2012. The repatriation of the fuel elements to the Russian Federation can be realized two year later, at the end of 2014 as soonest. The preliminary negotiations regarding the repatriation with the representatives of DOE have already started. Based on the experience gathered in 2008, the next step of the repatriation will also be flawless; thus another option shall not be sought for.*

According to plans, the operation of the Budapest Research Reactor will finish in 2023. The repatriation of the low enriched fuel assemblies will be possible in line with the effective intergovernmental agreement. The earliest possible date of transport is 2025. Nevertheless, as an alternative solution to repatriation the disposal within Hungary could also be mentioned.

Currently; spent fuel is not stored in the Training Reactor. The replacement of the irradiated fuel by fresh fuel as well as its transport is a theoretical option; the related technical aspects are under consideration.

B.2 Low and intermediate level waste

B.2.1 Practices

The solid and liquid radioactive wastes that are generated during the operation of the nuclear power plant are processed and temporarily stored in the plant. In addition to these wastes, radioactive wastes are generated in research institutes, in medical-, industrial-, and agricultural institutions and in laboratories.

Radioactive Waste Treatment and Disposal Facility

The repository for institutional low and intermediate level radioactive wastes, the Radioactive Waste Treatment and Disposal Facility, was commissioned in 1976. It is situated at Püspökszilágy some 40 km north-east of Budapest (see Figure B-1). The repository is a typical near-surface facility, composed of concrete trenches (vaults) and shallow wells for spent sealed sources.

At the moment, the Radioactive Waste Treatment and Disposal Facility is the only existing repository in Hungary.

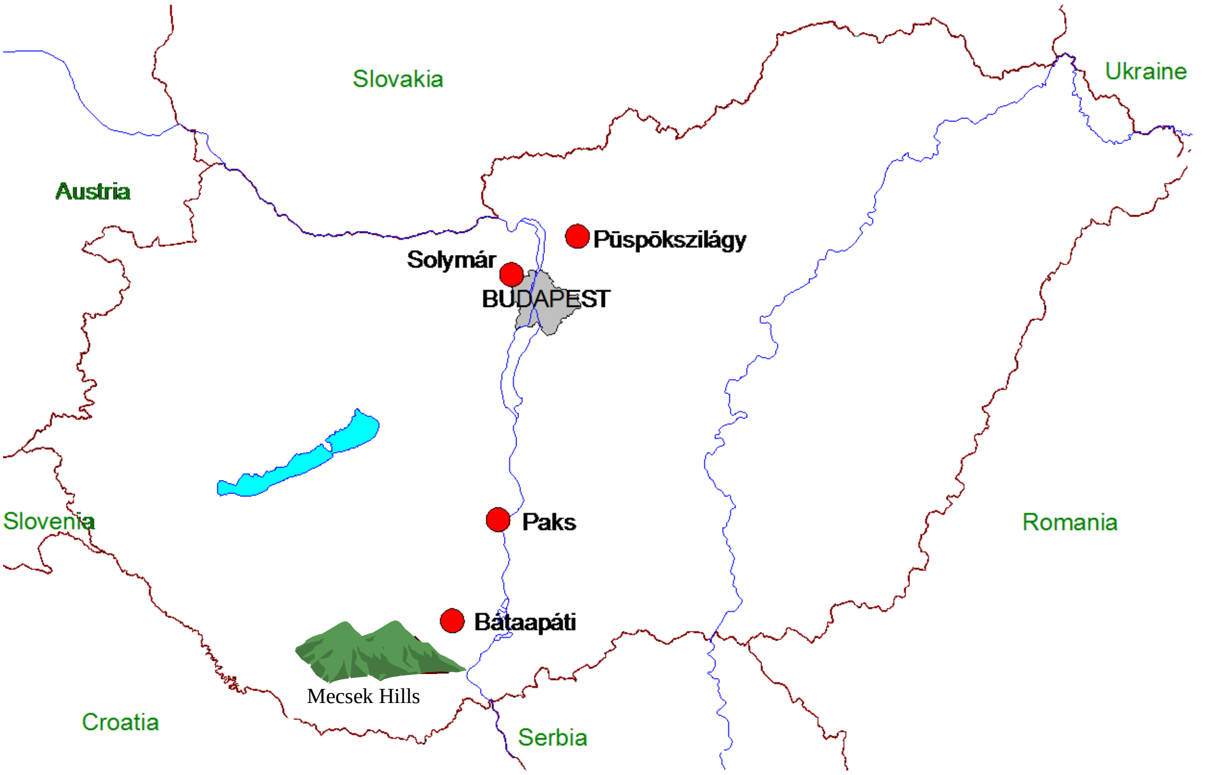


Figure B-1 Sites of importance in Hungary

The competent authority issued the final operational licence for the facility in 1980. In the absence of waste acceptance criteria, the repository has accepted almost all kinds of radioactive wastes generated during the utilisation of nuclear technology and isotope applications. Between 1979 and 1980, radioactive wastes stored up till then in a facility in Solymár were transferred for disposal to the Radioactive Waste Treatment and Disposal Facility. The Solymár site was cleaned up and closed as described in Section H.

Since 1 July 1998, the facility has been operated by PURAM.

Judging from the geological investigations, it is not possible to expand the Radioactive Waste Treatment and Disposal Facility for the disposal of the waste originating from the operation and decommissioning of Paks Nuclear Power Plant. The low-level, solid waste from Paks Nuclear Power Plant was transported to the repository in Püspökszilágy only as a provisional solution. At the same time the capacity of the Radioactive Waste Treatment and Disposal Facility was increased with the financial support of the power plant. The total capacity of the repository is now 5040 m^3.

The Radioactive Waste Treatment and Disposal Facility is operated based on the extendable license that is currently valid until 28 February 2015.

The results of the safety assessments, at the same time, unambiguously indicated that certain spent radiation sources may pose a risk in the distant future, after the closure of the repository in case of human intrusion (see Section H). Therefore, with the aim of enhancing the long term safety of the repository (effecting, in the first place, future generations), a multi-year programme was launched in the framework of which the 'critical' waste types are segregated from the recovered waste and then the rest are – as far as possible – compacted before re-disposal in the vaults. By doing this, the repository – which reached capacity in 2004 – can continue to accommodate the institutional radioactive waste from all over the country.

Bird's eye view of the Radioactive Waste Treatment and Disposal Facility

The facility is described in detail in Annex 2, the safety aspects are dealt with in Section H *and K.*

National Radioactive Waste Repository

Since the expansion of the Radioactive Waste Treatment and Disposal Facility to the extent that would satisfy the total needs of the nuclear power plant is impossible, after several attempts in early 1993 a national programme was launched with the aim of finding a solution for the final disposal of LLW/ILW of the plant.

In 1996, based on the final document resulting from the geological investigations as well as on safety and economic studies, further taking into account the willingness of host communities, a proposal was made to carry out further explorations for a geological disposal site in granite in the vicinity of Bátaapáti about 45 km south-west of Paks.

At the end of 1998 the Geological Institute of Hungary made a recommendation to start the detailed site characterisation in the Bátaapáti research area.

By 2003, as a result of the 4-year research programme, the surface-based geological investigations were completed. The geological authority concluded that the site fulfils all the requirements formulated in the relevant decree [III.3]. Thus, from the geological point of view, it is suitable for the disposal of low and intermediate level radioactive waste. *As the first phase of the construction of the repository, the surface facilities were completed in 2008, which* enables the temporary storage of a part of the solid waste from the nuclear power plant to take place later in 2008.

The competent Radiation Health Centre of the National Public Health and Medical Officer Service granted license for commissioning the National Radioactive Waste Repository on 25 September 2008; the scope of the license also covered the operation of the surface facilities.

Surface buildings of the National Radioactive Waste Repository

Further details about the establishment of the repository are given in Section H.

B.2.2 Policies

Radioactive Waste Treatment and Disposal Facility

It is expected that the repository will be able to dispose the institutional waste for several more decades after its safety and capacity have been increased.

The complete reconstruction of the treatment building located on the repository site has provided a long-term solution for centralised interim storage of those long lived wastes and spent radiation sources as well as wastes containing nuclear material *until the repository for the disposal of high level long lived radioactive wastes shall be completed.*

National Radioactive Waste Repository

Low and intermediate level waste of nuclear power plant origin generated during the operation and decommissioning of the plant will be disposed of in the National Radioactive Waste Repository. Closure of the repository is not planned prior to decommissioning the nuclear power plant. The repository – based on appropriate geological and geophysical measurements – can be expanded in order to accommodate the increased amount of waste stemming from the planned life-time extension of the nuclear power plant.

Section C. Scope of Application

ARTICLE 3. SCOPE OF APPLICATION

1. *This Convention shall apply to the safety of spent fuel management when the spent fuel results from the operation of civilian nuclear reactors. Spent fuel held at reprocessing facilities as part of a reprocessing activity is not covered in the scope of this Convention unless the Contracting Party declares reprocessing to be part of spent fuel management.*
2. *This Convention shall also apply to the safety of radioactive waste management when the radioactive waste results from civilian applications. However, this Convention shall not apply to waste that contains only naturally occurring radioactive materials and that does not originate from the nuclear fuel cycle, unless it constitutes a disused sealed source or it is declared as radioactive waste for the purposes of this Convention by the Contracting Party.*
3. *This Convention shall not apply to the safety of management of spent fuel or radioactive waste within military or defence programmes, unless declared as spent fuel or radioactive waste for the purposes of this Convention by the Contracting Party. However, this Convention shall apply to the safety of management of spent fuel and radioactive waste from military or defence programmes if and when such materials are transferred permanently to and managed within exclusively civilian programmes.*
4. *This Convention shall also apply to discharges as provided for in Articles 4, 7, 11, 14, 24 and 26.*

The Republic of Hungary ratified the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management on 2 June 1998 and promulgated it *by an act [I.11]* that requires the fulfilment of all the obligations of the Convention.

As to the scope of application - referred to in Article 3 of the Convention - Hungary declares the following:

- no decision has been taken on the back-end of the fuel cycle, so reprocessing is not part of the spent fuel management; there are no reprocessing facilities in Hungary;

- any waste that contains only naturally occurring radioactive material and does not originate from the nuclear fuel cycle is not radioactive waste from the viewpoint of the Convention;

- there is no spent fuel from military or defence programmes; the exclusively low and intermediate level radioactive wastes from the defence programmes of the Hungarian Ministry of Defence are disposed of with other institutional radioactive waste and they are included in the inventory of the radioactive wastes from civilian programmes.

Section D. Inventories and Lists

ARTICLE 32. REPORTING

2. This report shall also include:

(i) a list of the spent fuel management facilities subject to this Convention, their location, main purpose and essential features;

(ii) an inventory of spent fuel that is subject to this Convention and that is being held in storage and of that which has been disposed of. This inventory shall contain a description of the material and, if available, give information on its mass and its total activity;

(iii) a list of the radioactive waste management facilities subject to this Convention, their location, main purpose and essential features;

(iv) an inventory of radioactive waste that is subject to this Convention that:

(a) is being held in storage at radioactive waste management and nuclear fuel cycle facilities;

(b) has been disposed of; or

(c) has resulted from past practices.

This inventory shall contain a description of the material and other appropriate information available, such as volume or mass, activity and specific radionuclides;

(v) a list of nuclear facilities in the process of being decommissioned and the status of decommissioning activities at those facilities.

D.1 Spent Fuel

Spent fuel arises mainly as a consequence of the operation of Paks Nuclear Power Plant. In addition, the Budapest Research Reactor and the Training Reactor contribute to the generation of spent fuel.

In Hungary there is only one facility on the list of spent fuel management facilities, the Interim Spent Fuel Storage Facility. The main characteristics of this facility are described in Section B, its safety in Section G, further details are contained in Annex 1.

D.1.1 Inventory and rate of generation of NPP spent fuel

The four units of Paks Nuclear Power Plant are fuelled with fuel assemblies of VVER-440 type. The enrichment is between 2.4 and *4. 2*%. Based on our present knowledge, along *with the consideration of the 20 year service life extension,* the number of spent nuclear fuel assemblies that will have been generated by the end of the life-time of the nuclear power plant (2037) and may remain in Hungary will be about *17,900*, with approximately *2123 t* heavy metal content. Previously, between 1989 and 1998, altogether 2331 spent fuel assemblies with 273 t heavy metal content were shipped back to the Soviet Union (later to Russia).

The nuclear power plant is gradually increasing the burn-up level of the fuel and, accordingly, is decreasing the anticipated quantity of the spent nuclear fuel assemblies that will be generated during the planned life-time of the plant.

On 31 December *2010, 1,804* fuel assemblies were stored in the spent fuel (cooling) ponds of the nuclear power plant *and 6,547 fuel assemblies* in the Interim Spent Fuel Storage Facility, respectively.

At the end of 2007, the total capacity of the Interim Spent Fuel Storage Facility was 7,200 assemblies in 16 modules. *The extension of the storage facility with four new modules is in progress. In order to provide storage capacity for every spent fuel assembly remaining in the country, the storage facility shall be extended to accommodate 37 modules in total.*

Besides the above mentioned inventory, 72 storage canisters containing damaged fuel elements are being stored in the cooling pond of Unit 2 of the nuclear power plant. These are the residues of those 30 fuel assemblies that were damaged during the cleaning process in April 2003. This method of storage is to be used until a solution suitable for the final disposal is found. Neutron- and gamma-spectroscopy methods were developed and measurements were performed for quantitative and qualitative determination of the fission content of the residues.

At present, preparatory actions are in progress on extending the planned 30-year life-time of the nuclear power plant by 20 years. The service life extension will have an effect on both the amount and the management of radioactive waste and spent fuel. *In harmony with the 10th Medium and long term plan of PURAM (see Chapter F.1) the present report takes into consideration the consequences of service life extension.*

D.1.2 Inventory and rate of generation of the spent fuel of non-nuclear power plant origin

Currently, the Budapest Research Reactor operates with 228 fuel assemblies of VVR-M2 and VVR-M type (with an enrichment of 36% and 19.75% respectively). The fuel with an enrichment of 36% is continuously replaced in the core and intended to be repatriated to the Russian Federation after the completion of the conversion. These assemblies are used either as single fuel elements or as fuel bundles including a group of three. The 1,285 fuel elements of VVR-SZM and VVR-M2 type, which were removed from the core by September 2005, as well as 82 fuel elements of EK-10 type, were repatriated in 2008.

In total 363 spent fuel assemblies are stored on site having about 36 kg of heavy metal. The reactor is scheduled to operate until 2023; thus, from the end of 2010 to the end of its operational life, a further 830 VVR-M2 "single" spent assemblies (approximately equivalent to 83 kg heavy metal content) should be taken into account.

There are 24 - partly modified - assemblies of EK-10 type (with an enrichment of 10%) operating in the Training Reactor, and no spent fuel is stored on site. There is fresh fuel on the site: 28 EK-10 type assemblies and 37 separate fuel rods. From the technological viewpoint, it is conceivable that during the reactor operation lasting up to 2027 the core might be refuelled once, thus the total amount of spent fuel may be maximum 48 assemblies, containing 59 kg heavy metal.

D.2 Radioactive Waste

In Hungary there is only one facility on the list of radioactive waste management facilities, this being the Radioactive Waste Treatment and Disposal Facility. The main characteristics of this facility are described in Section B, its safety in Section H, further details are contained in Annex 2. *The National Radioactive Waste Repository is in construction, only the surface buildings are commissioned (see Section B and Section H).*

D.2.1 Classification of radioactive waste

The relevant ministerial decrees [III.15 and III.19] regulate the classification of radioactive wastes. That type of radioactive waste is qualified as low and intermediate level radioactive waste in which the heat production during the disposal (and storage) could be neglected. Further,

a) that low- and intermediate level radioactive waste is short-lived, in which the half-life of the radionuclides is 30 years or less, and it contains long-lived alpha emitter radionuclides only in limited concentration;
b) that low- and intermediate level radioactive waste is long-lived, in which the half-life of the radionuclides and/or the concentration of the alpha emitter radionuclides exceed the limits concerning short-lived radioactive waste.

That type of radioactive waste is high-level waste whose heat production shall be considered during the design and operation of storage and disposal.

Within the above classification the authority can prescribe more detailed classification for the low, intermediate and high level radioactive wastes.

Classification viewpoints for low and intermediate level radioactive wastes:

1. The classification of the radioactive waste into low and intermediate level classes shall be performed based on the activity-concentration and exemption activity-concentration (EAC) of the given radioisotope (Table D. 2.1-1).

Table D. 2.1-1 Classification of radioactive waste for one radioisotope

Radioactive waste class	Activity concentration (Bq/g)
Low level	1 EAC – 10^3 EAC
Intermediate level	> 10^3 EAC

2. If the radioactive waste contains more types of radioisotopes, then the classification shall be performed accordingly as follows (Table D.2.1-2):

Table D.2.1-2 Classification of radioactive waste for more than one radioisotope

Radioactive waste class	Activity concentration ratio
Low level	$\sum_i \frac{AC_i}{EAC_i} \leq 10^3$
Intermediate level	$\sum_i \frac{AC_i}{EAC_i} > 10^3$

where AC_i is the activity-concentration of the i^{th} radioisotope existing in the radioactive waste, and the EAC_i is the exemption activity-concentration of the i^{th} radioisotope.

The regulations on exemption and clearance of radioactive materials also apply to radioactive waste. Exemption levels are regulated by a ministerial decree [III.6] in accordance with the regulations of the European Union. The procedure of clearance from regulatory control is regulated by another ministerial decree [III.9]. According to this latter decree, substances containing radionuclides can be released from regulatory control if the projected annual individual dose originating from its re-use, or its re-utilisation or handling as non-radioactive waste does not exceed 30 μSv effective dose, and analysis proves that clearance is the optimum solution.

D.2.2 Inventory and rate of generation of HLW from the nuclear power plant

In Hungary, high level waste is generated basically in Paks Nuclear Power Plant, in relatively small quantities. It is stored in the reactor hall, in 1,114 storage tubes (pits) designed for this purpose. *At the end of 2010, approximately 94 m^3 of the total 222.8 m^3 storage capacity had been used.*

The rate of generation of high level radioactive waste is 3-5 m^3/year; thus the total volume expected to be generated till the end of the planned design life-time (30 years) of the nuclear power plant can be stored in the existing storage space. *The built-in storage capacity is not sufficient to store the total quantity of high level radioactive wastes expected to be generated during the 20 years of service life extension. It can be foreseen that storage capacity shall be provided between 2030 and 2035 by removing the low and intermediate level waste content of those high activity wastes that have such material content. The NPP launched a storage volume optimization programme which covers the retrieval and treatment of the wastes that are currently stored in pits.*

D.2.3 Inventory and rate of generation of LLW/ILW of non-nuclear power plant origin (institutional radioactive waste)

The small-scale, non-fuel-cycle producers such as hospitals, laboratories and industrial companies generate about *10 - 15 m^3* low and intermediate level waste and *300-1000 disused radioactive sources* per year. *To date, 3303 shipments were carried out from 570 different consignors. The low and intermediate level radioactive waste generated by the non-fuel-cycle producers and accepted until the end of 2005 occupied 2,540 m^3 repository volume.* Between 1983 and 1996 the nuclear power plant shipped 1580 m^3 low level solid waste to the facility, occupying about 2500 m^3 of the repository. The overall volume occupied by the waste is 5040 m^3*, thus the chambers serving for disposal were full at the end of 2005. Between 2005 and 2010 the wastes were stored in the storage area constructed in 2004, where 130 m^3 wastes were stored at the end of 2010. Out of this volume 50 m^3 was shipped from producers, while 80 m^3 is the waste that was removed from the disposal chambers in the framework of the safety improvement programme that was accomplished between 2007 and 2009. As a result of the aforementioned safety improvement programme about 100 m^3 capacity was unoccupied (by the compression of the waste and its partial placement in the storage area).*

At the end of 2010 the total activity of the radioactive wastes in the repository was 513 TBq based on the available data.

Most radioactive wastes, including spent sealed sources, are generated in medical, industrial and research applications. *The most widely used isotopes are ^{60}Co, ^{137}Cs, ^{90}Sr and ^{3}H.* The isotope composition of the waste disposed of in the Radioactive Waste Treatment and Disposal Facility is described in Annex 3.

D.2.4 Inventory and rate of generation of LLW/ILW from the nuclear power plant

The main radioactive waste producer in Hungary is Paks Nuclear Power Plant. The waste streams generated include solid and liquid wastes, spent ion-exchange resins, and contaminated oils. The small amount of radioactive waste generated in the Interim Spent Fuel Storage Facility is treated together with the waste of the nuclear power plant.

<u>Gaseous wastes:</u>

The discharging of gaseous radio-isotopes (tritium, radioactive noble gases, etc.) always takes place within the discharge limits, and under constant control. (See Annex 8.)

<u>Liquid radioactive wastes:</u>

Chemical waste waters containing radioactive isotopes are generated from various sources within the controlled zone of the nuclear power plant. After chemical treatment, the collected waste waters are evaporated to produce a concentrate containing about 200 g/dm^3 boric acid *The total volume of evaporation wastes produced up to 31 December 2010 was 5,925 m^3, of which 240 m^3 was generated during 2010. The total volume of evaporation waste includes 1,458 m^3 evaporator bottom – containing alpha radiants – produced during the period from the severe accident at Unit 2 in April 2003 to December 2010, which is stored in special tanks separately from the other concentrates. Bearing in mind the present 250 m^3/year generation rate for the evaporation wastes the total volume till the end of the 30 year service life will be 7,400 m^3. With the consideration of 20 year service life extension the total volume of 12,248 m^3 evaporation residue can be expected.*

A special tank was provided for the storage of evaporator acid solution. *Evaporator acidation solution was not generated in 2010; thus as at 31 December 2010 the tank contained the total volume of 200 m^3 evaporator acidation solution. Thus, as at 31 December 2010, this tank contained a total volume of 200 m^3 evaporator acid solution.* Bearing in mind the present 15 m^3/year generation rate for the evaporator acid solution *the total volume till the end of the planned 50 year service life will be 620 m^3.*

The total quantity of resins used up to 31 December 2010 was 170 m^3; 13.8 m^3 of this was generated during the year 2010. At present, there is no necessity for immediate processing of the ion exchange resins. *Bearing in mind the present 5 m^3/year generation rate for ion exchange resin, the total volume till the end of the 50 year service life will be 425 m^3.*

With a future modification of the storage tanks for spent ion exchange resins the resulting storage capacity of 870 m^3 is expected to be sufficient till the end of the extended service life of the nuclear power plant.

The decontamination solutions that arose during the elimination of the consequences originating from the serious incident at Unit 2 were collected in a separate tank. During the restoration activities a total of *560* m^3 decontamination solution was produced *up to 31 December 2010*.

By the end of the 50 years service life of the plant the total waste volume produced after liquid waste conditioning is estimated at 8,200 m^3.

<u>Solid radioactive wastes:</u>

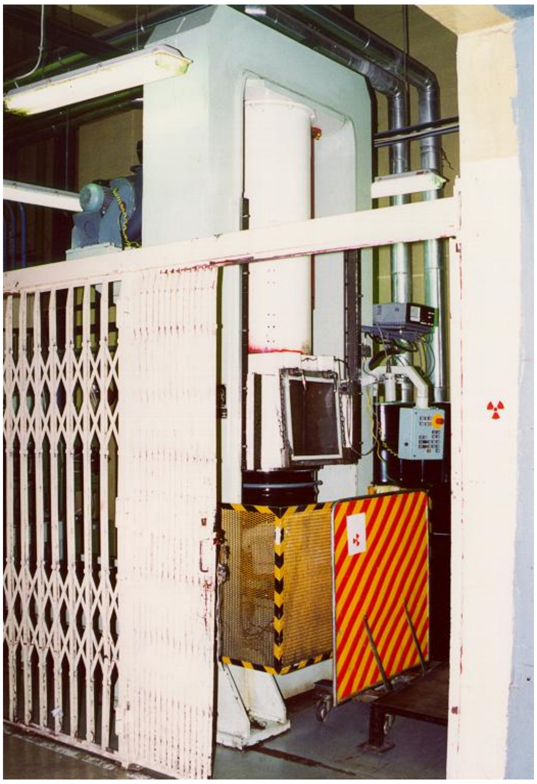
In accordance with the present practice, solid radioactive wastes are processed as follows:

- The compactable and non-compactable radioactive wastes are separated as early as during the collection in a way that non-compactable wastes are very rarely loaded into plastic bags.

- To reduce the volume of compactable radioactive waste, a 500 kN press is used, achieving an average reduction factor 5. In accordance with the experience gained so far, some 80-85% of the total solid radioactive wastes can be compacted.

- The active sludge was solidified with the addition of diatomaceous earth in a ratio of 1:1. (The ratio depends on the liquid content of the sludge.) Since March 2007, the solidification has been performed by settling and then removing the liquid content with an industrial suction cleaner rather than by soaking with diatomaceous earth.

- Solid waste, including aerosol filters and solidified sludge, is loaded uniformly into special 200 l metal drums (internally coated with plastic).



Waste compressor machine

As of *31 December 2010, 8,541 drums* loaded with low and intermediate level solid radioactive wastes were stored in the interim stores. Bearing in mind the present rate of waste generation, the annual quantity will be some 850 drums of 200 l capacity.

Taking into account the estimation for the annual quantity of waste for the presently considered 50-year service life, the total volume of solid wastes to be disposed of will be some 8,400 m^3.

Storage of low and intermediate level waste

D.2.5 Waste from the decommissioning of Paks Nuclear Power Plant

The decommissioning of nuclear facilities will produce a large volume of radioactive waste only in the case of Paks Nuclear Power Plant.

It is planned that only relatively small amounts of waste be produced by the early stages of decommissioning, e.g. from the removal of fuel and the flushing out of the reactor coolant circuits. *The accepted decommissioning strategy includes a 20 year protected preservation of the primary circuit; thus it entails postponed dismantling. The total estimated volume of low and intermediate wastes generated during the implementation of this decommissioning strategy is summarized in the table below.*

Table D.2.5 Total estimated volume of low and intermediate level waste generated during decommissioning

Decommissioning option	*number of containers having the dimensions 1.9 m*1.9 m*1.6 m*	*number of containers having the dimensions 2.3 m*2.3 m*1.4 m*
20 year long protected preservation of the primary circuit	*302*	*2,805*

The volume of HLW to be disposed of in the deep geological facility is estimated to be approximately 500 m^3.

Section E. Legislative and Regulatory System

ARTICLE 18. IMPLEMENTING MEASURES

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

The necessary legislative, regulatory and other measures to fulfil the obligations of the Convention have been taken and are discussed in this report.

E.1 Legislative and regulatory framework

ARTICLE 19. LEGISLATIVE AND REGULATORY FRAMEWORK

1. *Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of spent fuel and radioactive waste management.*
2. *This legislative and regulatory framework shall provide for:*
   - *(i) the establishment of applicable national safety requirements and regulations for radiation safety;*
   - *(ii) a system of licensing of spent fuel and radioactive waste management activities;*
   - *(iii) a system of prohibition of the operation of a spent fuel or radioactive waste management facility without a licence;*
   - *(iv) a system of appropriate institutional control, regulatory inspection and documentation and reporting;*
   - *(v) the enforcement of applicable regulations and of the terms of the licences;*
   - *(vi) a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management.*
3. *When considering whether to regulate radioactive materials as radioactive waste, Contracting Parties shall take due account of the objectives of this Convention.*

The Hungarian Parliament approved the Act on Atomic Energy [I.6] in December 1996, it entered into force on 1 June 1997. The codes and guides of the International Atomic Energy Agency provided a basis for the establishment of the Act, and recommendations of the European Union and the OECD Nuclear Energy Agency were also considered.

The main characteristics of the Act on Atomic Energy are that it:

- declares the priority of safety;
- declares that the control and supervision of the safe use of nuclear energy are Government tasks; the Government fulfils its tasks through the Hungarian Atomic Energy Authority, and the responsible ministers;
- defines the regulatory competences of the Hungarian Atomic Energy Authority and of the minister responsible for health in the licensing procedures;
- defines and allocates the competences and tasks of other bodies of the public administration involved in the application of atomic energy;
- declares the organisational and financial independence of the licensing and supervising authorities;
- outlines the general framework for the utilisation of human resources, education, research and development;

- defines the responsibility of the licensee for all nuclear damage, and fixes the sum of liability in accordance with the revised Vienna Convention;
- entitles the Hungarian Atomic Energy Authority to impose a fine on a licensee for infringing a legal regulation or a safety code, or failing to comply with an obligatory standard (prescribed by the authority) or with the provisions set forth in an individual regulatory licence issued based on the above;
- requires that the Government appoints - as it is in the national interest - an organisation responsible for the final disposal of radioactive waste, for the interim storage and final disposal of spent fuel, and for the decommissioning of nuclear facilities;
- prescribes the establishment of a Central Nuclear Financial Fund intended solely for financing the final disposal of radioactive waste, the interim storage and final disposal of spent fuel elements, and for the decommissioning of nuclear facilities;
- *prescribes the obligation of physical protection, regulates that the licensees shall prevent the unauthorized access to their nuclear and other radioactive materials, facilities and equipment, the loss of control above them and their diversion toward non-licensed applications, in addition it requires that the nuclear facilities and repositories shall be protected by armed guards.*

There are two more or less specific issues in Hungary defined by the Act on Atomic Energy:

- *The Act states that radioactive waste management facilities (e.g. repositories) are not considered as nuclear facilities.*
- The other specific issue is that the Act, *and the implementation decrees thereof,* establish a so-named divided authority and regulatory system. From the viewpoint of the Convention's aims it means that the principal licensing and supervising authority for spent fuel management is the Hungarian Atomic Energy Authority; *with regard to radioactive waste the public administration bodies responsible for health (regionally competent radiation health centres working within the public health professional administration organizations of the capital and county government offices, and the Office of the Chief Medical Officer of the National Public Health and Medical Officer Service).*

As far as radiation protection is concerned, the Act on Atomic Energy allocates regulatory tasks to several ministries. The basic regulation of radiation protection belongs to the *minister responsible for health*. The technical side of radiation protection in nuclear facilities and spent fuel management belongs under the regulatory authority of the Hungarian Atomic Energy Authority. Protection of the environment - including the general regulation of releases - belongs to the minister responsible for environmental protection. The Operation Limits and Conditions, approved by the Hungarian Atomic Energy Authority, include the derived limits of radioactive releases from the operation of Paks NPP. Tasks related to the radioactivity of the soil and flora belongs to the scope of the minister responsible for agriculture.

According to the Act on Atomic Energy [I.6] users of atomic energy shall ensure that the generation of radioactive waste through their activity is held to the lowest possible level. In the application of atomic energy, provisions shall be made for the safe storage or disposal of radioactive waste and spent fuel in accordance with the most recent, certified results of science, international expectations, as well as experience, in such a way that no unacceptable burden is passed on to future generations.

Considerations of environment protection issues concerning spent fuel and radioactive waste management are given in act on environmental protection [I.5]. This Act applies to projects that may have significant environmental impacts. Construction of a new spent fuel storage or a radioactive waste repository always requires an environmental licensing procedure based on an environmental impact assessment. The Act also calls for hearings of citizens in local and neighbouring municipalities and of other interested groups. These issues are within the competence of the minister responsible for environmental protection.

Hungary is also committed to the international agreements concerning environmental impact assessment. As a member of the European Union, Hungary also complies with the relevant Council Directive 2001/42/EC of the European Parliament and of the Council on the assessment of the effects of certain plans and programmes on the environment.

Service life extension of the Paks NPP

The extension of service life of Paks Nuclear Power Plant by 20 years is on the agenda in Hungary, which requires both a new environmental license issued within the framework of an environmental protection procedure and a new operating license to be issued within the framework of a nuclear safety licensing procedure.

The environmental protection license was issued by the competent authority in 2006; it became effective, subsequent to an appeal procedure, on 31 January 2007. In accordance with the regulations of Govt. decree on nuclear safety authority procedures [II.25] Paks NPP Ltd submitted a programme to the HAEA in 2008 in order to establish the operational conditions for service beyond the designed lifetime and to demonstrate the operability of the plant. The HAEA accepted the programme with a resolution and monitors its implementation. One year prior to the end of the design service life (i.e. in 2011 for Unit 1) the licensee shall submit the license application for the operation beyond the designed lifetime. The compilation of the document supporting the license application is in progress (see Chapter D.1.1).

E.1.1 Spent fuel management

Later, once the sixth annex of the governmental decree [II.25] of 2005 had entered into force, the nuclear safety code for spent fuel interim storage facilities was issued. The application of the safety codes is supported by guidelines: eighteen guidelines are related to the spent fuel storage facilities with dry storage; additional guidelines are being elaborated as appropriate.

E.1.2 Radioactive waste management

The Act on Atomic Energy [I.6] authorises the minister responsible for health to determine in a decree the dose limits for employees engaged in the field of atomic energy applications and the limits of the population's radiation dose. In this respect, the executive order of the Act on Atomic Energy [I.6] is the decree of the minister responsible for health [III.9]. The dose limits in the decree are in accordance with the values laid down in the IAEA’s Basic Safety Standards and in the 96/29/Euratom Directive.

The radiation protection requirements of the final disposal of radioactive waste are also set down in a decree [III.15] of the minister responsible for health. This decree stipulates the following:

- Final disposal of radioactive waste can be licensed in a manner and on a site only if the disposal does not impose an unacceptable risk to society and does not harm human life, the health of present and future generations, the human environment, and goods.
- Members of the public living in the closest neighbourhood of the facility should not be exposed to a yearly effective dose above 100 μSv, and in the case of individual events involving damage to or destruction of the disposal system, the collective risk shall not exceed the value of 10^{-5} event/year.
- When designing a disposal facility, a design basis shall be set up, and the components of the planned disposal system shall be ranked in design safety classes.
- Disposal technology shall be designed in such way that the waste could be retrieved in the operational phase.
- Depending on the given operation stage of the repository a full-scale or partial safety report shall be prepared for the disposal system.
- Waste acceptance criteria shall be set up for the disposal facility.
- Operation licences for final disposal are grantable for 10 years and for interim storage for 5 years, but these licences could be extended on the basis of a safety review.
- In the post-closure period the operator is required to provide supervision of the facility for the monitoring of radiation in the environment and the prevention of the intrusion of persons and animals for at least 50 years, and after that date for as long as the authority requires it.

Regarding the geological aspects in radioactive waste management, a ministerial decree [III.3] prescribes the methodology and geological requirements of site selection and characterisation, the essential elements of quality assurance and control, the general geological and mining requirements, as well as details of the licensing procedure. Annex 1 of this decree – with the title: General Research Aspects for Geological Site Suitability of Nuclear Facilities and Radioactive Waste Disposal Facilities – contains a table of facilities in relation to geological aspects with the proposed rankings for evaluating the geological characteristics. Three other annexes prescribe the special geological requirements.

E.2 Regulatory body

ARTICLE 20. REGULATORY BODY

1. *Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 19, and provided with adequate authority, competence and financial and human resources to fulfill its assigned responsibilities.*
2. *Each Contracting Party, in accordance with its legislative and regulatory framework, shall take the appropriate steps to ensure the effective independence of the regulatory functions from other functions where organizations are involved in both spent fuel or radioactive waste management and in their regulation.*

E.2.1 The Hungarian Atomic Energy Authority

According to the Act on Atomic Energy [I.6], the relevant authority regarding nuclear facilities and thus regarding, among others, the spent fuel management facilities is the Hungarian Atomic Energy Authority (see governmental decree [II.21]).

The HAEA is a government office dealing with peaceful usage of atomic energy, acting under the control of the government with independent task and regulatory competence; it is independent both organizationally and financially. The HAEA is supervised by a minister designated by the prime minister (in the reporting period the minister for national development) independently of his portfolio. The HAEA cannot be instructed in its scope of authority defined by law.

Licensing (at facility, system and system-element level) and inspection of the nuclear safety of nuclear facilities, accountancy for and control of nuclear and other radioactive materials as well as the licensing of related shipments and packaging designs, taking a stand as special authority in the licensing procedure of nuclear export and import, evaluation and coordination of research and development related to the safety of the application of atomic energy, fulfilment of regulatory tasks falling under its jurisdiction in the field of nuclear emergency preparedness, approval of emergency response plans of nuclear facilities, and the related international relations all come under the competence of the HAEA.

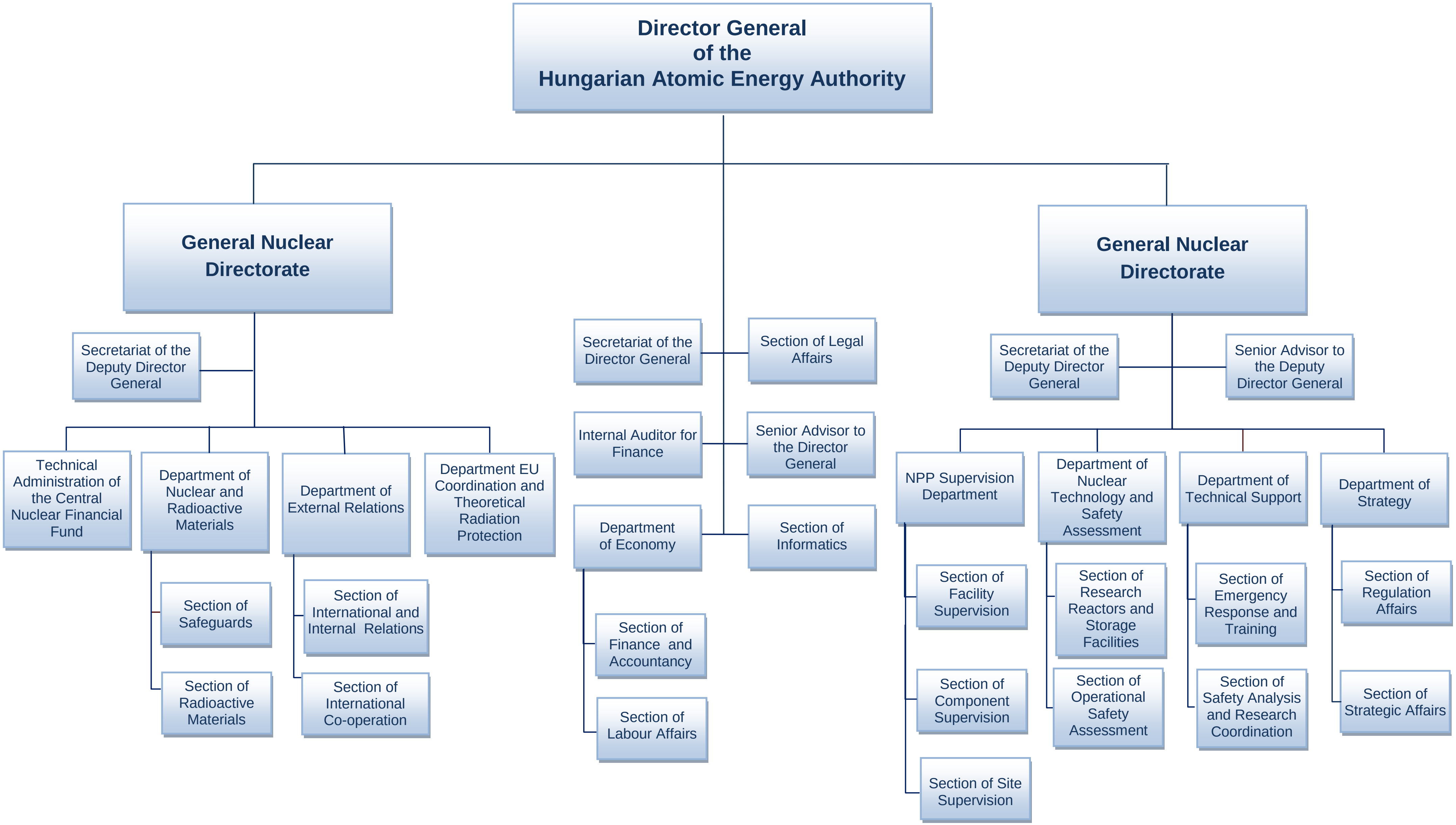


Fig. E.2.1-1 Organisational structure of the Hungarian Atomic Energy Authority

The legislation supports the involvement of experts (being either institutes or private experts) into the work of the HAEA, in the cases when it does not possess the required expertise. In order to provide an appropriate scientific background for its activities, the Authority has concluded agreements with several scientific institutions. Such an agreements seal its cooperation with the KFKI Atomic Energy Research Institute, the Institute of Nuclear Techniques of the Budapest University of Technology and Economics, the Nuclear Safety Research Institute, and with the Institute of Isotopes of the Hungarian Academy of Sciences.

In accordance with the Act on Atomic Energy [I.6], the work of the Authority is also supported by a Scientific Board that is composed of members having a national reputation. The Board's main function is to deal with major issues of principles as well as to consider those areas of research and development that are related to nuclear safety and the prevention of nuclear accidents.

E.2.2 The public health administration bodies

With regard to issues concerning radiation protection (radiation protection of employees and of the public, performance of tasks related to public health and radiation health matters) the related tasks *are dealt with by the regionally competent radiation health centres working within the public health professional administration organizations of the capital and county government offices, and the Office of the Chief Medical Officer of the Public Health and Medical Officer Service according to the relevant governmental decree [II.31] and ministerial decrees [III.9 and III.15]*. This also applies to spent fuel management facilities.

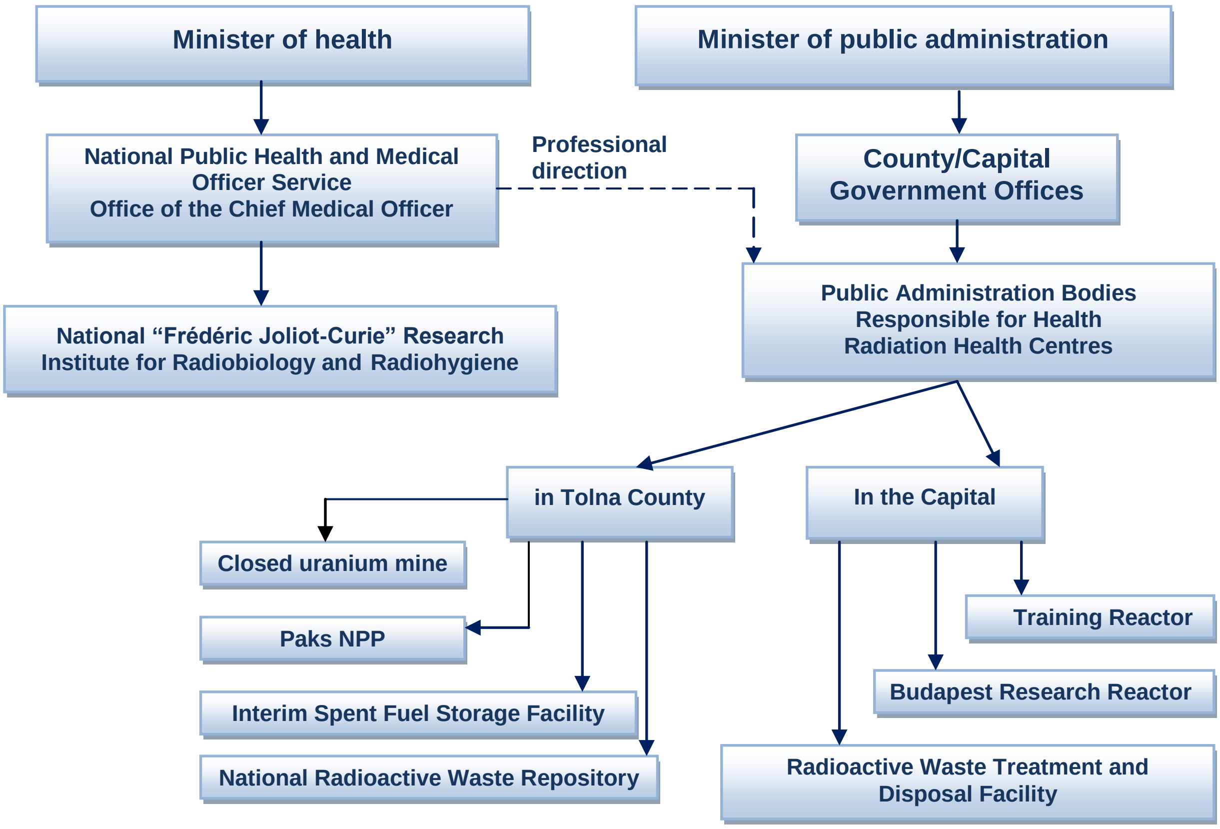


Figure E.2.2-1 Structure of the radiation health authorities and their supervisory system

The national *expert body and authority*, the Office of the National Chief Medical Officer, is the licensing authority for radiation protection regulation, the health physics service section of the *major* facilities, and it also participates in the nuclear safety licensing procedures as a special authority on radiation protection questions. An institute of the National Public Health and Medical Officer Service, the National Research Institute for Radiobiology and Radiohygiene, maintains the personal dosimetry services (evaluation of the compulsory authority personal dosimeters and operation of the national personal dosimetry register).

The radiation health centre working within the public health professional administration organization of the Tolna County Government Office is empowered to supervise (including field inspections) the adherence to radiation protection rules and prescriptions in spent fuel management activities.

E.3 Licensing procedure

E.3.1 Spent Fuel Management

The basic principles of the licensing procedure for spent fuel management facilities are analogous to those of all other nuclear facilities.

In concordance with the regulations in force, a nuclear safety licence should be obtained from the authorities for all periods during the lifecycle of an interim spent fuel storage facility. Moreover, separate licences must be obtained for all changes of construction to a given facility or modifications of its components/constructions should they belong to safety classes. In addition to this, the Authority grants building and occupancy licences for buildings and structures.

Within the licensing procedures, the specific aspects are dealt with by the special authorities designated by law [II.21] *[II.31]* (see also E.3.2). The Hungarian Atomic Energy Authority has to take into consideration the additional requirements (stipulations and conditions) of these specialised authorities. Before applying for a construction or decommissioning licence an environmental protection licence is a prerequisite.

Licences are valid for a given period of time, and may be extended upon request of the licensee if all requirements are met.

Any nuclear facility that operates without a licence, or operates contrary to a valid licence falls under the Penal Code [I.2]; among the consequences for an operator of a facility found guilty in these respects is a severe sentence of imprisonment.

E.3.2 Radioactive Waste Management

The *regionally competent radiation health centres working within the public health professional administration organizations of the capital and county government offices, and the Office of the Chief Medical Officer of the Public Health and Medical Officer Service*, with expert advice and technical assistance provided by the National Research Institute for Radiobiology and Radiohygiene perform the licensing procedures.

In the licensing procedure all the other relevant public administration organisations participate as so-named special authorities. These special authorities designated in the *government decree [II.31]* have jurisdiction in the following cases:

- the regionally competent Inspectorate for Environment, Nature and Water enforces aspects relating to environment protection, nature conservation, protection of water quality, water utilisation and protection of water bases;
- the building authority competent for the area enforces aspects relating to regional planning and building;
- *the HAEA enforces aspects in relation to the accountancy for and control of nuclear and other radioactive materials, as well as to nuclear emergency preparedness and response;*
- the Hungarian Police Headquarters enforces aspects relating to public security and police administration;
- *the chief of staff of the National Defence Forces enforces the defence aspects;*
- the competent County Directorate for Emergency Management and the Capital Directorate for Civil Defence as well as the Capital Headquarters of the Fire Service enforce aspects relating to civil defence and fire protection;
- *the regionally competent mine authority enforces aspects relating to mining technology, mining safety and geology.*

Further to those mentioned above, pursuant to Govt. decree [II.27], the below listed authorities shall be involved in the construction and operation licensing procedure of the Bátaapáti National Radioactive Waste Repository:

- *the Food Chain Safety and Animal Health Directorate and the Plant and Soil Protection Directorate of the Tolna County Government Office which enforces aspects relating to animal health, food protection, plant and soil protection;*
- *the Transport Inspectorate of the Tolna County Government Office which enforces aspects relating to public and cargo transport.*

E.4 Inspection

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 applications of nuclear energy.

The authority is entitled to perform inspections both with advance notice, or without notice should the latter be considered justified. Inspections may also be performed by associated external experts or expert bodies upon the written commission of the authority.

In addition to the HAEA's inspection activities, the special authorities taking part in the licensing procedure or giving their separate licenses may also carry out separate official inspections.

In order to ensure the controlled deployment of atomic energy and to evaluate the activity of the licensee, the authorities operate a reporting system. Reports prepared for the authorities are detailed so as to enable independent review, evaluation and assessment of operating activities, and any noteworthy events that may have taken place.

The investigation and assessment of any events affecting safety that have occurred during operation and the identification of the causes and the taking of corrective actions and measures in order to prevent their repeated occurrence is primarily the task of the licensee.

The Hungarian Atomic Energy Authority evaluates annually the safety performance of all licensees based on the results of a Safety Performance Indicator System. The aim of this evaluation is the regulatory assessment of the activities and safety performance of a licensee, and thus monitoring and assessing the safety indicators of the operation as well as identifying probable safety gaps in a timely manner.

The periodic reassessment of the nuclear safety of nuclear facilities is performed every ten years on the basis of a comprehensive, predefined programme (taking into consideration the present international practice). This is the Periodic Safety Review process required by the various legal provisions. Decisions on keeping the operation license further in force, and – *if necessary* – on the possible prescription of further safety enhancement measures as a precondition of that are taken within the framework of this programme by the Authority (see Section K1).

In the field of radioactive waste management, the *regionally competent radiation health centres working within the public health professional administration organizations of the government offices* carry out regular inspection and surveillance of licensees. Furthermore, they check the licensed modifications and any extraordinary events. The objectives of inspection and surveillance are to:

- check compliance with radiation safety;
- check compliance with the prescribed conditions;
- perform in situ radiation surveys;
- take samples for laboratory measurements;
- make a protocol or take a decision in the case of any abnormal situation.

From the legal viewpoint, the radioactive waste disposal facility is regarded as a special institution, and it is required to undergo a full-scale annual inspection by the competent authority. In practice, the competent *authorities* inspect the Radioactive Waste Treatment and Disposal Facility at Püspökszilágy *and the National Radioactive Waste Repository* twice a year. During this inspection the authority supervises the site and carries out environmental sampling in the vicinity. The results of the environment monitoring are published also in the annual reports of the National Environmental Radiation Protection Monitoring System (OKSER) set up by governmental decree [II.20]. (These annual reports are accessible on the internet: http://www.okser.hu.)

The central registration of radioactive wastes falling within the scope of the Act on Atomic Energy is a further means of the regulatory supervision of radioactive wastes; this task belongs to the competence of the HAEA.

According to the relevant directives of Euratom and recommendations of the IAEA, the HAEA maintains a computerized system for registering radioactive materials (including wastes). The Ministerial decree [III.19] that became effective in April 2010 extended the scope of radioactive materials to be registered to include radioactive wastes. In accordance with the new decree a licensee shall keep such a local register, which provides up-to-date information on the actual inventory, type, activity, and storage location of radioactive wastes under its *ownership. The local register shall be maintained by software provided to the licensees by the HAEA free of charge. The inspection frequencies of local registers were specified within the framework of a risk-informed inspection regime considering the estimated probability and consequences of loosing regulatory control over radioactive sources.*

E.5 Enforcement of the regulatory requirements

The conditions for enforcing legal mandates of the authorities are included in the Act on the general rules of regulatory procedures and services in the public administration, in the Penal Code, and in governmental decrees.

In order to enforce the requirements of the regulations the authority is entitled to initiate an administrative procedure and, within the framework of this, may - if the situation arises - oblige the licensee to eliminate any deviations from the regulations that may be detected.

The authority can oblige the licensee to pay a fine if there is an infringement of any requirement of law, safety regulations, or if the licensee fails to meet the stipulations of any decision/resolution *being in force*. In cases falling under the Penal Code [I.2] the authority has a reporting obligation.

SECTION F. OTHER GENERAL SAFETY PROVISIONS

> **ARTICLE 21. RESPONSIBILITY OF THE LICENCE HOLDER**
>
> 1. Each Contracting Party shall ensure that prime responsibility for the safety of spent fuel or radioactive waste management rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.
> 2. If there is no such licence holder or other responsible party, the responsibility rests with the Contracting Party which has jurisdiction over the spent fuel or over the radioactive waste.

F.1 Responsibility of the licence holder

In general, the Act on Atomic Energy [I.6] and its executive orders make the licensee responsible for the safe use of atomic energy and the fulfilment of safety related requirements. In the context of the Convention it means that prime responsibility for the safety of spent fuel management and radioactive waste management rests with the holder of the relevant operational licences of spent fuel management facilities and radioactive waste management facilities, the PURAM.

PURAM is responsible for the following activities:

- elaboration of *its* medium- and long-term plans (strategies);
- elaborating cost estimates to identify the necessary payments into the Central Nuclear Financial Fund (see F.2.2.2) each year;
- preparation of technical and financial reports for the activities financed from the Fund;
- preparation for the construction of facilities for the storage and disposal of radioactive wastes and their establishment;
- construction (extension) and operation of the storage facility for interim storage of spent nuclear fuel, viz. the Interim Spent Fuel Storage Facility;
- completion of work required for decommissioning of nuclear facilities *(after final shut-down of nuclear facilities – till the demolition – the maintaining, guarding, decommissioning of nuclear facilities and remediation of their sites);*
- operation of the existing low- and intermediate level repository *of institutional wastes*, i.e. the Radioactive Waste Treatment and Disposal Facility;
- *operation of the nuclear power plant originated low and intermediate level waste repository, the National Radioactive Waste Repository;*
- provision of information and maintaining public relations.

The basic tasks of PURAM as a licensee are – *within its field of activities* – as follows:

- to establish the technical, technological, financial and human conditions for the safe operation of the facilities;
- to elaborate a safety policy which reflects implementation of the principle that safety prevails over all other considerations;
- to elaborate, introduce and maintain an appropriate management system;
- to prevent the occurrence of any supercritical nuclear chain reaction;
- to prevent the evolution of any unacceptable damage affecting employees, the public, the environment, material assets, caused by ionising radiation or any other factor;

- to keep the exposures of the personnel and the public as low as reasonably achievable (taking into account the social and economic factors);
- to take into account, from the aspect of safety, the limits of human performance;
- to establish and operate a radiation protection (health physics) service which plans and controls all actions and measurements necessary to adhere to the basic principles of radiation protection;
- to maintain (regulatory and/or its own) dosimetry control;
- to derive the estimated annual discharge limits from the dose constraint specified by the radiohygiene authority and to submit them for approval to the environmental protection authority and to the nuclear safety authority;
- to determine the planned (airborne and liquid) discharges for normal operation;
- to ensure compliance with the annual discharge limits;
- to monitor/control continuously radiation levels and concentrations of the radionuclides in the environment and provide the local public with relevant information;
- to maintain an appropriate organisation which is capable of accomplishing in due time each and every prescribed periodic and event reporting obligation (including categorisation of all events according to the International Nuclear Event Scale (INES));
- to ensure that the qualifications, professional education, and health of the employees are in line with the prescribed requirements;
- to carry out continuous activities in order to maintain the highest possible level of safety including evaluation of all relevant operation experience, and to finance the costs of related research and development activities;
- to regularly revise and upgrade the licensee's own management system in order to fulfil the safety-related requirements;
- to qualify subcontractors and suppliers for the task, taking into account that their quality management system prescribed by law is a prerequisite;
- to maintain an emergency preparedness organisation, to have ready emergency plans as required to handle all possible emergency situations on-site, and to co-operate with the local, regional and national level emergency forces;
- to ensure the physical protection of the site by armed guards, and to prevent unauthorised persons from access to nuclear materials and equipment;
- to ensure the financial coverage of indemnity (insurance);
- to maintain the necessary records prescribed for the inventories of nuclear and radioactive materials, and the operational data necessary for the evaluation of safety and the planning of decommissioning;
- to participate in the fulfilment of obligations of the Republic of Hungary arising from international treaties, conventions, and multilateral and bilateral agreements.

As a means of regulating responsibilities and measures for all orphan or confiscated radioactive/nuclear materials (spent fuel and radioactive wastes included) a governmental decree [II.9] is in force.

The licensee should, according to the *governmental decree [II.30]* on the National Nuclear Emergency Response System

- fulfil tasks related to consequences of events occurring during transportation of nuclear and radioactive materials and of violent intrusions;
- fulfil obligations to supply data necessary to alarm, notify and inform the public whenever the discharge limits are or may be exceeded and assure the conditions thereof;

- supply data on the activity and composition of airborne and liquid discharges in the case of a severe, rapidly developing event; estimate the consequences and give advice for the introduction of countermeasures.

F.2 Human and Financial Resources

> **ARTICLE 22. HUMAN AND FINANCIAL RESOURCES**
>
> Each Contracting Party shall take the appropriate steps to ensure that:
>
> (i) qualified staff are available as needed for safety-related activities during the operating lifetime of a spent fuel and a radioactive waste management facility;
>
> (ii) adequate financial resources are available to support the safety of facilities for spent fuel and radioactive waste management during their operating lifetime and for decommissioning;
>
> (iii) financial provision is made which will enable the appropriate institutional controls and monitoring arrangements to be continued for the period deemed necessary following the closure of a disposal facility.

F.2.1 Human and financial resources of the authorities

F.2.1.1 The Hungarian Atomic Energy Authority

The number of employees of the Hungarian Atomic Energy Authority, *in the recent years is 85 people* of whom more than 2/3 hold a higher education degree (university or college), most of them have two degrees (the second degree usually being in the area of nuclear techniques). In addition, many of the staff have scientific degrees, and most of them are fluent in one or more foreign languages.

A systematic education plan has been prepared by the Authority for training their inspectors. The plan is based on individual training profiles and consists of three basic training types: introductory training, re-training, and advanced courses. The accident prevention preparatory programme is an independent and permanent part of the education plan.

In order to ensure stable working conditions for the Hungarian Atomic Energy Authority, the Act on Atomic Energy provides two financial sources:

- a specific sum should be provided annually from the state budget to cover:
  - the costs of R&D activities necessary for supporting the regulatory work of the Authority,
  - the costs necessary for activities of the Authority related to the prevention and handling of nuclear accidents,
  - the costs of the Authority covering its international obligations;
- the licensees of nuclear facilities are obliged to pay a supervision fee to the Authority in the way and to the extent defined in the Act on Atomic Energy [I.6], and prescribed also in the Act on the annual central budget.

The Hungarian Atomic Energy Authority performs its regulatory activities impartially, independently of the nuclear facilities, and its funding is sufficient to carry out its duties efficiently. *At the same time some problems in human resources appeared when performing* *certain activities because of the decrease in the number of staff that occurred in the last years and because of the rate of earnings stated in the act on public servants.*

F.2.1.2 The National Public Health and Medical Officer Service

In Hungary, the licensing of radioactive waste management *falls under the competence of the regionally competent radiation health centres working within the public health professional administration organizations of the government offices, and the National Chief Medical Officer Authority of the Public Health and Medical Officer Service (health administration organizations) [II.31]*.

The public health authorities are independent from the sphere of the licensees. In 7 regional radiological centres some *60* well-qualified experts are employed in the field of radiation protection. Each centre is supplied by appropriate radiation measurement instruments and well-equipped laboratories. In special cases, the regulatory tasks are supported by the National Research Institute for Radiobiology and Radiohygiene (with about *80* highly qualified employees). The National Radiation Hygiene Preparedness Service with its appropriately equipped vehicle provides a 24-hour service every day.

The health administration organizations are public administration offices financed from the state budget.

F.2.2 Human and financial resources of the licensee

F.2.2.1 Human resources

The Act on Atomic Energy [I.6] states that the performance of tasks related to the final disposal of radioactive waste, as well as to the interim storage and final disposal of spent fuel, and to the decommissioning of a nuclear facility is of national interest, therefore it shall be the responsibility of an organisation designated by the Government. In view of this, the Government commissioned with a decree [II.14] the Director General of the Hungarian Atomic Energy Authority with the task of establishing this organisation (See Section B). The financial resources for the operation of this organisation, PURAM, are provided from the Central Nuclear Financial Fund. The status and operational conditions of PURAM as a public utility are defined by the Act on business organisations [I.13] and the Act on non-profit organisations [I.8].

The organisational scheme of PURAM is shown in Figure F.2.2.1-1.

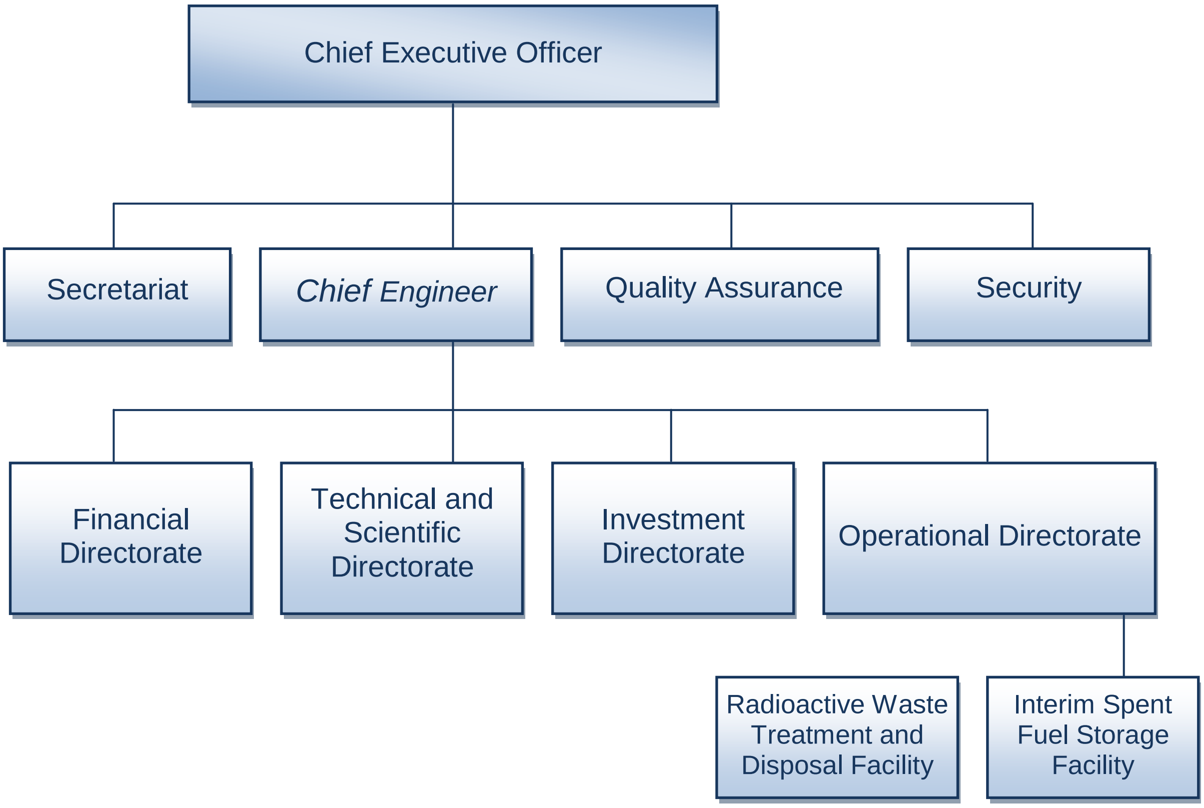


Figure F.2.2.1-1 Organizational scheme of PURAM

The central offices of PURAM are in Budaörs, close to Budapest. The management and administrative activities within each directorate are performed at Paks *and at Bátaapáti*. The Radioactive Waste Treatment and Disposal Facility is situated in Püspökszilágy. *174 employees are working at three sites, including 80 security guards. The operation and maintenance of the Spent Fuel Interim Storage Facility, on a contractual basis, is performed by the staff of the Paks Nuclear Power Plant Ltd under the direction of PURAM.*

In connection with the operation of the Spent Fuel Interim Storage Facility, in accordance with the relevant legal requirements, the professional and health physics qualification requirements of the employees of PURAM are the same as for the employees of Paks Nuclear Power Plant.

F.2.2.2 Financial resources

As required by the Act on Atomic Energy [I.6], the Minister supervising the Hungarian Atomic Energy Authority disposes over the Central Nuclear Financial Fund operating as of 1 January 1998, while the Hungarian Atomic Energy Authority is responsible for its management. The Fund is a separate state fund pursuant to the Act on public finance [I.4], primerly earmarked for financing the construction and operation of disposal facilities for the final disposal of radioactive waste, as well as for the interim storage and final disposal of spent fuel, and the decommissioning of nuclear facilities.

A long-term plan (lasting up to the decommissioning of the various nuclear facilities), a medium-term plan (for five years), and an annual work schedule on the use of the Fund are being prepared by PURAM. The long- and medium-term plans are to be reviewed annually and revised as required.

The long- and medium-term plans and the annual work schedule are to be approved by the minister supervising the Hungarian Atomic Energy Authority.

The payments into the Fund are defined in accordance with these plans. The annual payments into the Fund by Paks Nuclear Power Plant are proposed by the minister supervising the Hungarian Atomic Energy Authority, in the course of the preparation of the Act on the Central Budget of the next year. Payments are based upon submittals prepared by PURAM and approved by the Hungarian Atomic Energy Authority and by the Hungarian Energy Office.

The institutes disposing radioactive waste in the Radioactive Waste Treatment and Disposal Facility are also liable to contribute to the Fund in accordance with the official price list contained in a ministerial decree [III.8].

For nuclear facilities financed from the central budget (Budapest Research Reactor and Training Reactor), the sources required to cover payments into the Fund are provided by the central budget, when they arise.

The rate of payments into the Fund shall be specified in such a way as to provide appropriate sources for all costs of radioactive waste and spent fuel management and the decommissioning of nuclear facilities. These sources also provide coverage for public control and information activities as well as for the operational expenses of the existing repositories.

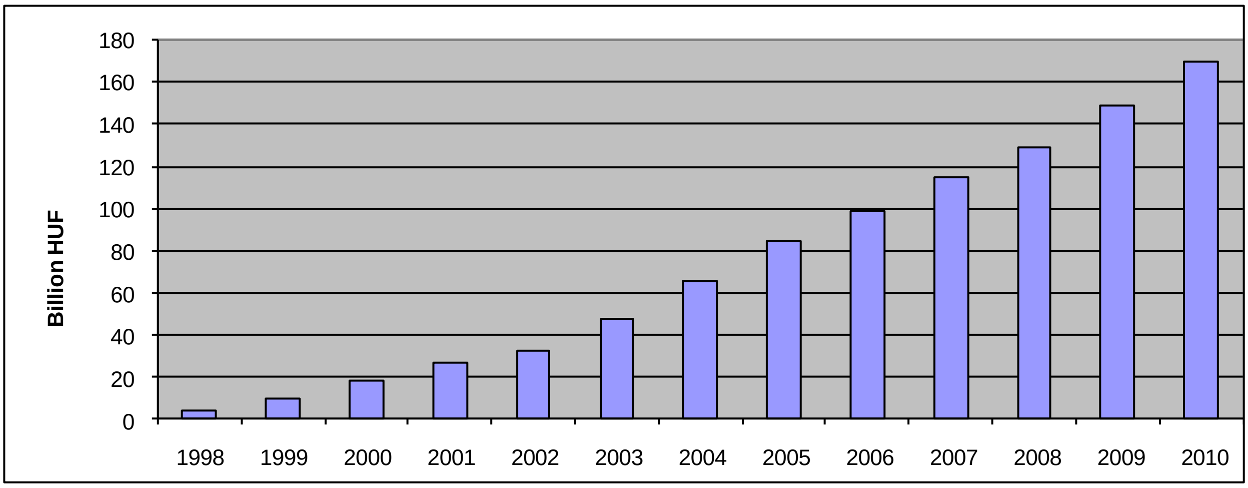
In order to ensure that the Fund maintains its value, the Government contributes to the Fund with a sum that is calculated on the average assets of the Fund in the previous year using the average base interest rate of the central bank in the previous year.

The Central Nuclear Financial Fund is managed within an individual account of the Hungarian State Treasury. The State Audit Office of Hungary annually audits the budget planning of the Fund, the execution of the budget plan and the fulfilment of tasks.

Table F.2.2.2-1 Financial data of the Fund between 1998 and 2010

	Income	***Expenditure***	***Increase of assets (MHUF)***
1998	*7 777.4*	*3 941.1*	*3 836.3*
1999	*9 399.0*	*3 634.6*	*5 764.4*
2000	*10 449.0*	*2 094.1*	*8 354.9*
2001	*14 886.9*	*6 084.0*	*8 802.9*
2002	*17 205.8*	*11 239.4*	*5 966.4*
2003	*23 703.2*	*9 183.5*	*14 519.7*
2004	*27 577.0*	*9 705.9*	*17 871.1*
2005	*30 497.1*	*11 026.9*	*19 470.2*
2006	*28 445.9*	*14 680.4*	*13 765.5*
2007	*29 184.9*	*13 068.6*	*16 116.3*
2008	*31 362.6*	*16 288.8*	*15 073.8*
2009	*33 751.4*	*13 913.6*	*19 837.8*
2010	*35 646.0*	*15 003.6*	*20 642.4*

The assets of the Fund amounted to HUF 170.02 billion HUF as of 31 December 2010 (please note that 1 Euro was 267 HUF on 31 March 2011).



Increase of the balance of CNFF between 1998 and 2010

F.3 Quality Management

> **ARTICLE 23. QUALITY ASSURANCE**
>
> Each Contracting Party shall take the necessary steps to ensure that appropriate quality assurance programmes concerning the safety of spent fuel and radioactive waste management are established and implemented.

All facilities dealing with spent fuel management, in line with all other nuclear facilities, are obliged by the Act on Atomic Energy [I.6] and the relevant governmental decree [II.25] to operate under an appropriate quality management system. The system shall be presented to the Hungarian Atomic Energy Authority as a constituent part of the safety analysis report prescribed in the safety code. Nuclear Safety Code, Vol. 6 of the governmental decree also contains prescriptions on the functioning of the licensee's quality management system. The Hungarian Atomic Energy Authority is empowered by law to inspect the effectiveness of the quality management system of the licensee.

All organisations contracted by the licensee and working on *nuclear* safety-classified systems/structures/components are obliged to maintain a quality management system. Prior to concluding a contract with the suppliers, the licensee shall qualify them in the selection process to decide whether they are suitable for the assigned task, and also whether the proposed quality management system is appropriate.

PURAM introduced a Quality Management System based on ISO 9001:2000 and an Environmental Management System based on ISO 14001:1996 standards. *Their introduction and the compliance with the new versions of the referred standards were certified by an accredited organization.* Furthermore it is worth mentioning that the Hungarian Atomic Energy Authority itself has established its own quality management system based on the ISO 9001:2000 standard. This quality management system was certified in December 2002 and the Authority has a valid certificate since that time.

The regulatory tasks, including measurements, of the public health authorities are also carried out under a *quality management programme*. *Most of the laboratories operate a management system, accredited by the National Accreditation Body, according to the requirements of the relevant legal regulations and the ISO/IEC 17025:2005 standard.*

F.4 Operational radiation protection

> **ARTICLE 24. OPERATIONAL RADIATION PROTECTION**
>
> 1. Each Contracting Party shall take the appropriate steps to ensure that during the operating lifetime of a spent fuel or radioactive waste management facility:
>   (i) the radiation exposure of the workers and the public caused by the facility shall be kept as low as reasonably achievable, economic and social factors being taken into account;
>   (ii) no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection; and
>   (iii) measures are taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment.
> 2. Each Contracting Party shall take appropriate steps to ensure that discharges shall be limited:
>   (i) to keep exposure to radiation as low as reasonably achievable, economic and social factors being taken into account; and
>   (ii) so that no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection.
> 3. Each Contracting Party shall take appropriate steps to ensure that during the operating lifetime of a regulated nuclear facility, in the event that an unplanned or uncontrolled release of radioactive materials into the environment occurs, appropriate corrective measures are implemented to control the release and mitigate its effects

As demonstrated in Section E, the Hungarian legal regulations require that the radiation exposure of the workers and the public shall be kept as low as reasonably achievable, and no individual shall be exposed, in normal situations, to radiation doses beyond the dose limitation set by the relevant ministerial decree. The implementation of these requirements as well as the measures taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment are described in Annexes 1 and 2 respectively for spent fuel management and radioactive waste management facilities.

Based on the authorisation of Act [I.6], decree [III.12] of the minister responsible for environment protection regulates the radioactive releases to the atmosphere and into waters in the course of using atomic energy, together with the monitoring of the releases and of the environment. According to the decree, the licensees of nuclear facilities and radioactive waste repositories have to derive the annual release limits as well as the planned release levels from the dose constraint specified by the Office of the National Chief Medical Officer. For example, the dose constraint for Paks Nuclear Power Plant is 90 μSv/year, for the Interim Spent Fuel Storage Facility 10 μSv/year, for the Radioactive Waste Treatment and Disposal Facility *and the National Radioactive Waste Repository* 100 μSv/year, for the Budapest Research Reactor 50 μSv/year, for the Training Reactor 50 μSv/year and for the remediation of the closed uranium mine area 300 μSv/year. The release limits as well as the planned release levels shall be submitted for approval to the regionally competent Inspectorate of the

Environment, Nature and Water. The licensees have to measure and determine the releases, monitor the environment in compliance with the requirements of the decree, and to prepare regular reports on the results to the authority. They are required to enable the authority to carry out sampling and on-site measurements for monitoring radioactive releases and supply the authority with samples if required.

In accordance with the legal regulation and confirmed by the regulatory authority, the actual discharges from nuclear facilities are well below the release limits.

F.5 Emergency Preparedness and Response

> **ARTICLE 25. EMERGENCY PREPAREDNESS**
>
> 1. Each Contracting Party shall ensure that before and during operation of a spent fuel or radioactive waste management facility there are appropriate on-site and, if necessary, off-site emergency plans. Such emergency plans should be tested at an appropriate frequency.
> 2. Each Contracting Party shall take the appropriate steps for the preparation and testing of emergency plans for its territory insofar as it is likely to be affected in the event of a radiological emergency at a spent fuel or radioactive waste management facility in the vicinity of its territory.

F.5.1 Emergency response organization

The National Nuclear Emergency Response System was renewed by a government decree promulgated in 2010 [II.30]. The legislation, which was accepted with consensus among experts, takes into consideration the further developed international recommendations, the recent experience, and thus defines the national preparation in a basically new structure. It reflects the concept of continuous operation, and - criterion based – the concept of operating states of the National Nuclear Emergency Response System. It can be concluded that an up-to-date decree was born, which provides a basis for the more effective operation of the National Nuclear Emergency Response System.

The National Nuclear Emergency Response System regulated by the above mentioned decree is an essential part of the general disaster management system established as the implementation of the Act on protection against catastrophes [I.10]. The central body of the command structure is the Governmental Coordination Committee, whose chairperson is the minister responsible for the defence against emergencies, and its members are made up of the competent ministers.

The subordinated organs of the Governmental Coordination Committee are the Nuclear Emergency Response Defence Working Committee and the Nuclear Emergency Response Scientific Council.

In the case of a nuclear emergency the expert decision support is the task of the Nuclear Emergency Response Defence Working Committee. The proposals for actual interventions are elaborated by the Operative Staff. The Public Information Group working under the Operative Staff is responsible for the coordination of public communication activity.

The main task of the Nuclear Emergency Response Scientific Council is to provide a technical-scientific basis for emergency preparedness, emergency decision support, emergency decision making, as well as for the mitigation of consequences.

The execution of nuclear emergency response tasks falls under the responsibility of the chief executive officers on the various sites of nuclear facilities, the presidents of the regionally competent County (Capital) Defence Committees in the counties and the capital, and the chairperson of the Governmental Coordination Committee at national level.

Under non-emergency conditions the organizations of the National Nuclear Emergency Response System conduct preparatory work and exercises. Certain organizations perform, apart from preparation, continuous data gathering, planning, and information or cooperation tasks.

F.5.2 Sectoral and local nuclear emergency response organisations

The order of direction and operation of the sectoral system are determined by heads of the concerned ministries and authorities of the central administration. Establishment of special organisations for nuclear emergency, designation of forces and tools to be applied in the response, local emergency planning and maintenance of the plan are the tasks of the County (Capital) Defence Committees.

F.5.3 National Nuclear Emergency Response Plan

In 2006 the High Level Working Group was established for the revision and maintenance of the National Nuclear Emergency Response Plan. The revision was based on the experience gained during national nuclear emergency response exercises, the recommendations identified in the report on the severe incident occurring at the Paks NPP in 2003, the relevant new legislations and the new international recommendations. The new version of the Plan was issued in 2008 as a result of the two-year-long efforts of the High Level Working Group. In comparison with the former version, the most significant changes are: the extension of the planning and intervention objectives, the definition of operating states and their criteria, the extension of emergency classification to radiological emergencies, the re-definition of the action and intervention levels, the development of national level procedures to be implemented in the case of events that do not exceed the action and intervention levels, and the definition of public information tasks.

The Governmental Coordination Committee approved the new version of the National Nuclear Emergency Response Plan and ordered that the organizations of the national system shall review or, if needed, develop their own plans based on the new National Plan. The Governmental Coordination Committee authorized the High Level Working Group to harmonize the nation-wide planning and to develop guidelines in expert questions that are not regulated in sufficient detail by the National Plan.

The High-level Working Group of the Governmental Coordination Committee commenced the revision of the National Emergency Response Plan in 2010. The review aims at adopting the new ministerial responsibilities derived from the reorganization of the government structure, and by reasonably reducing the size of the document based on the experience gained from the development and application of the Plan. The issuance of methodical guidance in connection with the Plan was continued; two guidelines were published in 2010: the "Organized *assistance in response" and the "Local management of a radiological emergency". The legal background of the High-level Working Group was strengthened in 2010 by the promulgation of the above mentioned new decree [II.30].*

F.5.4 Emergency preparedness in the facilities

F.5.4.1 Interim Spent Fuel Storage Facility

The Paks Nuclear Power Plant and the Interim Spent Fuel Storage Facility have an integrated emergency preparedness system and response organization, as their sites are neighbouring. The emergency situations included in the planning cover all types of nuclear emergencies that could occur in the nuclear power plant or in the storage facility. The emergency management system established at the nuclear power plant is capable of managing all spent fuel management related and radioactive waste management related accidents in both facilities. The emergency preparedness activities are specified by the Nuclear Emergency Response Plan valid for the given facility.

The Nuclear Emergency Response Plan of the Interim Spent Fuel Storage Facility shall be reviewed and approved biannually by the Hungarian Atomic Energy Authority.

F.5.4.2 Radioactive Waste Treatment and Disposal Facility

In 2007 the Radioactive Waste Treatment and Disposal Facility introduced a new Nuclear Emergency Response Plan which is harmonized with the Hungarian legal background and with international expectations. The new plan has been approved by the National Public Health and Medical Officer Service. *The nuclear emergency response plan of PURAM was revised and updated based upon the new National Emergency Response Plan; it was submitted for approval in March 2011.*

F.5.4.3 National Radioactive Waste Repository

The commissioning license for the operation of the surface facilities was granted to the National Radioactive Waste Repository in 2008. A condition for the license was the preparation of the emergency response plan. The emergency response plan was approved, based on the expert opinion of the National "Frédéric Joliot-Curie" Research Institute for Radiobiology and Radiohygiene, by the National Chief Medical Officer Authority.

F.5.5 Preparation and exercises

The emergency preparedness and exercise activities at spent fuel storage and radioactive waste repository facilities are realized pursuant to the facility emergency response plans. According to law, the plans shall define the qualification requirements for the personnel of the emergency response organization and their preparation, regular training and exercises. The legislation requires the organization of more significant emergency exercises at regular intervals. The potential participation and contribution of off-site emergency organizations shall be assured in such exercises. The conduction of exercises are regularly observed by the Hungarian authorities within the framework of field inspections.

The preparation and exercising of the off-site emergency response organizations is performed according to annual plans that are developed on the basis of the National Emergency

Response Plan. Each organization is responsible for the preparation of its own emergency response organization.

Hungary, as a member of the OECD Nuclear Energy Agency regularly takes part in the INEX international nuclear emergency response exercises, and in the various CONVEX exercises of the International Atomic Energy Agency. Since 2003 Hungary has been a member of the ECURIE, the early notification system of the European Union and as such it takes part in the exercises organized in the framework of ECURIE.

F.5.6 International cooperation

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

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

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

The Republic of Hungary agreed, in 1991, to utilize INES, introduced by the International Atomic Energy Agency.

Hungary has been a member of the harmonization project of the International Atomic Energy Agency on nuclear accident prevention and emergency response since its beginning. This project significantly contributed to the renewal of the National Nuclear Emergency Response Plan.

Hungary joined the European Community Urgent Radiological Information Exchange (ECURIE) system already before joining the European Union.

Hungary has concluded bilateral agreements with the following countries in the areas of early notification, mutual provision of information, and co-operation in nuclear emergency matters: Austria(1987), the Czech Republic and the Slovak Republic (1991), the Federal Republic of Germany (1991), Slovenia (1995), Romania (1997), Ukraine (1997) and Croatia (2000).

F.5.7 RESPEC support

The Hungarian Atomic Energy Authority signed the RESPEC (Radiological Emergency Support Project for the European Commission) contract at the end of 2006, in the framework of which the Hungarian Atomic Energy Authority provides the European Commission with professional support for three years in the case of nuclear and radiological emergencies which have an effect on the European Union. The duties contracted entered into effect as of 1 April 2007. Based on the contract the Emergency Response Organisation of the Hungarian Atomic Energy Authority, at the request of the European Commission, provides professional support in nuclear and radiological evaluation of an emergency, and in public communication. *As recognition of the successful work, and as a result of the successful bid for the tender called for the next three years, the HAEA repeatedly won the assignment until the end of 2013.*

F.6 Decommissioning

ARTICLE 26. DECOMMISSIONING

Each Contracting Party shall take the appropriate steps to ensure the safety of decommissioning of a nuclear facility. Such steps shall ensure that:

(i) qualified staff and adequate financial resources are available;

(ii) the provisions of Article 24 with respect to operational radiation protection, discharges and unplanned and uncontrolled releases are applied;(iii) the provisions of Article 25 with respect to emergency preparedness are applied; and

(iv) records of information important to decommissioning are kept

Decommissioning is not a current question for the Hungarian nuclear facilities. Nevertheless this question has been covered in regulations, as the final phase of the life-cycle of the facilities.

Within the framework of the on-going regulation modernization project the Hungarian Atomic Energy Authority intends to publish requirements for decommissioning of nuclear facilities as a separate volume of the Nuclear Safety Code. The new requirements are based upon the decommissioning reference levels of the Western European Nuclear Regulators' Association – WENRA.

For licensing of decommissioning, a *multi*-step licensing procedure is established, where the first step is to obtain the HAEA's consent to terminate operation. A further requirement is a valid environmental protection licence based on environmental impact assessment and public hearing. Radiation protection authorities *have a role* in these licensing processes, and they license separately the appropriate radiation protection programme and radiation protection organisation. During the dismantling, decontamination and other steps, an ongoing task of the authority is the control of the radiation situation within the facility and around it, and the monitoring of personal doses and the discharges and the radiation in the environment. Emergency plans have to be updated with new or likely scenarios and any necessary organisational changes required must be adjusted accordingly.

With regard to the Paks Nuclear Power Plant, the Budapest Research Reactor, the Training Reactor and the Interim Spent Fuel Storage Facility, the safety codes contain provisions that decommissioning shall be taken into account at the design stage, and *the abstract (summary) of the* preliminary decommissioning plan constitutes an obligatory part of the documentation prior to commissioning as well as of the final safety assessment. The decommissioning plan is required to be regularly revised in accordance with the regulations in force; revision results are required to be submitted to the Hungarian Atomic Energy Authority. The finalised decommissioning plan is a prerequisite of the licensing procedure aimed at decommissioning. All decommissioning plans have to cover organisational and qualification questions together with the technical issues.

In the case of Paks Nuclear Power Plant no preliminary decommissioning plan was originally made. This situation was corrected in the early 1990s and since that time it has been updated regularly. The third revision of the plan *was* carried out in 2008.

In the case of the Budapest Research Reactor and the Training Reactor the IAEA provided professional support, in the form of expert missions, to prepare the preliminary decommissioning plans. Such a mission took place in the Budapest Research Reactor in 2010. Now both facilities have Preliminary Decommissioning Plans, approved by the Hungarian Atomic Energy Authority.

The Interim Spent Fuel Storage Facility was already designed by taking into account all relevant requirements of decommissioning, *so this facility already possessed a simplified preliminary decommissioning plan. The periodic safety review conducted in 2008 demanded that this document shall be revised, based upon the comments of the authority, by the middle of 2011*.

Section G. Safety of Spent Fuel Management

ARTICLE 4. GENERAL SAFETY REQUIREMENTS

Each Contracting Party shall take the appropriate steps to ensure that at all stages of spent fuel management, individuals, society and the environment are adequately protected against radiological hazards. In so doing, each Contracting Party shall take the appropriate steps to:

(i) ensure that criticality and removal of residual heat generated during spent fuel management are adequately addressed;

(ii) ensure that the generation of radioactive waste associated with spent fuel management is kept to the minimum practicable, consistent with the type of fuel cycle policy adopted;

(iii) take into account interdependencies among the different steps in spent fuel management;

(iv provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;

(v) take into account the biological, chemical and other hazards that may be associated with spent fuel management;

(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;

(vii) aim to avoid imposing undue burdens on future generations.

ARTICLE 5. EXISTING FACILITIES

Each Contracting Party shall take the appropriate steps to review the safety of any spent fuel management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility.

The safety of spent fuel in Paks NPP and in the Budapest Research Reactor is dealt with in Annex 8.

G.1 Interim Spent Fuel Storage Facility

Siting

ARTICLE 6. SITING OF PROPOSED FACILITIES

1. *Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed spent fuel management facility:*
   - *(i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime;*
   - *(ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment;*
   - *(iii) to make information on the safety of such a facility available to members of the public;*
   - *(iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.*
2. *In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 4.*

The facilities of the Interim Spent Fuel Storage Facility are located 500 m south of the geometric centre of the power plant units. The foundation of the Interim Spent Fuel Storage Facility was designed at an elevation such that the facility would not be flooded even taking into account the Danube's maximum flood level that had occurred in 100 years. The structure of the basement prevents the release of radionuclides into the ground and groundwater. The Interim Spent Fuel Storage Facility is sited within a flight exclusion zone of 3 km diameter and 7000 feet (2133 m) altitude around Paks Nuclear Power Plant.

The design-basis earthquake levels used, following a conservative approach, for the seismic assessments are:

- 0.08 g horizontal acceleration for a design earthquake;
- 0.35 g horizontal acceleration for a maximum design earthquake.

Re-evaluation of the seismic hazard of the site defined a maximum horizontal seismic ground acceleration value of 0.25 g at an earthquake frequency of one in 10,000 years.

In the absence of site-specific response spectra values, data from the US NRC Reg. Guide 1.60 were used for the reassessments. The actual site-specific response spectra data were included in the approved seismic risk assessment report prepared after completion of the licensing process.

Design and construction

ARTICLE 7. DESIGN AND CONSTRUCTION OF FACILITIES

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

(i) the design and construction of a spent fuel management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;

(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a spent fuel management facility are taken into account;

(iii) the technologies incorporated in the design and construction of a spent fuel management facility are supported by experience, testing or analysis.

The reception building of the modular interim storage system and the first three storage modules was completed in 1996. The facility was commissioned in 1997. In 2007 the facility already contained 16 modules. The 16 modules constructed are suitable for storing 7,200 spent fuel assemblies. *The facility is operated in parallel with its expansion*.

The increase of storage capacity is in harmony with the demands of Paks NPP. The planned 37 modules are assumed to be capable of storing all spent fuel generated until the end of the extended service life of the plant. Beginning with module 17 of the Interim Spent Fuel Storage Facility square arrangement will be applied for the storage tubes instead of triangular arrangement that is used in modules 1-16; consequently 527 storage tubes can be stored instead of the original 450. When the storage facility reaches its maximum planned capacity it will be capable to store a total of 18,267 fuel assemblies within the 37 modules.

Interim Spent Fuel Storage Facility

A description of the Interim Spent Fuel Storage Facility is given in Annex 1.

Design specifications related to the decay heat and cooling time of fuel:

- *min. 3.5 year cooling before placing in the store,*
- *maximum of initial enrichment: 4.2%,*
- *average burn-up level: 47.25 GWday/tU,*
- *maximum burn-up level: 54 GWday/tU,*
- *482 W/assembly residual heat production for average burn-up level,*
- *720 W/assembly residual heat production for the maximum burn-up level*
- hermetic (intact) assemblies.

The cooling of the spent fuel assemblies is provided by a self-regulating passive cooling system, by a natural draft-induced airflow around the fuel storage tubes. No mixing can take place between the outside cooling air and the gas within the storage tube.

Safety Assessment

ARTICLE 8. ASSESSMENT OF SAFETY OF FACILITIES

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

(i) before construction of a spent fuel management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;

(ii) before the operation of a spent fuel management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

The safety assessment reported in the Final Safety Assessment Report of the Interim Spent Fuel Storage Facility was performed by AEA Consultancy Services, Risley, commissioned by GEC Alsthom. The assessment was performed to demonstrate that appropriate means are available for controlling criticality both in normal operational and in off-normal conditions within a specified range, and that nuclear safety is not jeopardised by any potential events.

The data provided by NRC Standard Review Plan, NUREG 0800, Section 9.1.1, "New Fuel Storage Facility", were used as design criteria for the assessment.

The nuclear safety assessment of the Interim Spent Fuel Storage Facility demonstrated that appropriate control of criticality is provided for under all normal operational and all assumed off-normal conditions, and the facility meets the regulatory safety requirements.

In addition to the safety assessment, in 2002 the licensee launched a programme on aging management. The programme *has been operating since*, and includes the regular inspection and testing of all safety-related systems and system components, beyond the normal maintenance work. A computer database was established for recording the operational safety parameters of the systems of the facility. Based on the evaluations it could be concluded that no problems were explored by the analyses carried out that would affect the safety indicators of the Interim Spent Fuel Storage Facility.

Re-fuelling machine in the Interim Spent Fuel Storage Facility

Operation of the facility

> ***ARTICLE 9. OPERATION OF FACILITIES***
>
> *Each Contracting Party shall take the appropriate steps to ensure that:*
>
> *(i) the licence to operate a spent fuel management facility is based upon appropriate assessments as specified in Article 8 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;*
>
> *(ii) operational limits and conditions derived from tests, operational experience and the assessments, as specified in Article 8, are defined and revised as necessary;*
>
> *(iii) operation, maintenance, monitoring, inspection and testing of a spent fuel management facility are conducted in accordance with established procedures;*
>
> *(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a spent fuel management facility;*
>
> *(v) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;*
>
> *(vi) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;*
>
> *(vii) decommissioning plans for a spent fuel management facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body.*

The holder of the operation licence of the Interim Spent Fuel Storage Facility is PURAM.

The Interim Spent Fuel Storage Facility’s operation and maintenance are performed on a contractual basis by the personnel of Paks Nuclear Power Plant. PURAM supervises the operation and maintenance works.

The operation licence issued by the Hungarian Atomic Energy Authority is valid until *30 November 2018*. The approval provided by the licence relates to the storage of spent nuclear fuel assemblies (of defined parameters) unloaded from Paks Nuclear Power Plant. The loading rate shall not be higher than 500 spent fuel assemblies per calendar year. The conditions for extending the licence are discussed in Section K.1.

In accordance with the operation licence, for safety related matters, the Nuclear Safety Code for Interim Storage Facilities; Dry Storage Facilities (Nuclear Safety Codes Vol. 6) issued as an attachment to the relevant governmental decree [II.25] shall be applied.

The operation limits and conditions are included in the technical specification of the Interim Spent Fuel Storage Facility. These were also approved by the licensing authority (the Hungarian Atomic Energy Authority) in accordance with the legal rules.

The Final Safety Analysis Report describes the information required to ground the safe operation and licensing of the Interim Spent Fuel Storage Facility. The licensee reviews yearly the Final Safety Analysis Report.

The safety criteria applied to the Interim Spent Fuel Storage Facility are in full accordance with internationally accepted principles, because the limits and conditions prescribed in the national regulations were derived from these principles.

During the long term dry storage of spent fuel in nitrogen gas medium at low temperatures the appropriate cooling is ensured while at the same time the mechanical and isolation properties of the assemblies are maintained. During storage, the level of radioactivity decreases thereby excluding any increase of impact on future generations – meaning that the operation of the Interim Spent Fuel Storage Facility will not impose an undue burden on future generations.

G.2 Disposal of spent fuel

> ***ARTICLE 10. DISPOSAL OF SPENT FUEL***
>
> *If, pursuant to its own legislative and regulatory framework, a Contracting Party has designated spent fuel for disposal, the disposal of such spent fuel shall be in accordance with the obligations of Chapter 3 relating to the disposal of radioactive waste.*

With respect to the disposal of high level waste and spent nuclear fuel, the policies and practices followed by Hungary are described in Section B. As mentioned there, it is a strategic target to establish a waste repository for the disposal of the country's high level radioactive wastes in a deep, geological formation to provide long-term isolation. In accordance with international viewpoints, such a *deep, geological* repository can be used for the direct disposal of spent nuclear fuels and would also be suitable for the reception of wastes from fuel reprocessing. No decision has yet been taken on the back-end of the fuel cycle. Thanks to the existence of the Interim Spent Fuel Storage Facility, there is sufficient time to elaborate the national policy and strategy.

Based upon the new international recommendations (IAEA, OECD/NEA) of the last decade, the document "Concept for content, finance and schedule to update the long term programme for research of Boda Clay Stone Formation" and the comments thereon of the Swiss based NAGRA company dealing with radioactive waste management, the preparation of the new programme addressing the siting of the necessary underground research laboratory began in 2010.

Section H. Safety of Radioactive Waste Management

ARTICLE 11. GENERAL SAFETY REQUIREMENTS

Each Contracting Party shall take the appropriate steps to ensure that at all stages of radioactive waste management individuals, society and the environment are adequately protected against radiological and other hazards.

In so doing, each Contracting Party shall take the appropriate steps to:

- *(i) ensure that criticality and removal of residual heat generated during radioactive waste management are adequately addressed;*
- *(ii) ensure that the generation of radioactive waste is kept to the minimum practicable;*
- *(iii) take into account interdependencies among the different steps in radioactive waste management;*
- *(iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;*
- *(v) take into account the biological, chemical and other hazards that may be associated with radioactive waste management;*
- *(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;*
- *(vii) aim to avoid imposing undue burdens on future generations.*

ARTICLE 12. EXISTING FACILITIES AND PAST PRACTICES

Each Contracting Party shall in due course take the appropriate steps to review:

- *(i) the safety of any radioactive waste management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility;*
- *(ii) the results of past practices in order to determine whether any intervention is needed for reasons of radiation protection bearing in mind that the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and the costs, including the social costs, of the intervention.*

ARTICLE 13. SITING OF PROPOSED FACILITIES

1. *Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed radioactive waste management facility:*
   - *(i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime as well as that of a disposal facility after closure;*
   - *(ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment, taking into account possible evolution of the site conditions of disposal facilities after closure;*
   - *(iii) to make information on the safety of such a facility available to members of the public;*
   - *(iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.*
2. *In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 11.*

ARTICLE 14. DESIGN AND CONSTRUCTION OF FACILITIES

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

- *(i) the design and construction of a radioactive waste management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;*

(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a radioactive waste management facility other than a disposal facility are taken into account;

(iii) at the design stage, technical provisions for the closure of a disposal facility are prepared;

(iv) the technologies incorporated in the design and construction of a radioactive waste management facility are supported by experience, testing or analysis.

ARTICLE 15. ASSESSMENT OF SAFETY OF FACILITIES

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

(i) before construction of a radioactive waste management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;

(ii) in addition, before construction of a disposal facility, a systematic safety assessment and an environmental assessment for the period following closure shall be carried out and the results evaluated against the criteria established by the regulatory body;

(iii) before the operation of a radioactive waste management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

ARTICLE 16. OPERATION OF FACILITIES

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

(i) the licence to operate a radioactive waste management facility is based upon appropriate assessments as specified in Article 15 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

(ii) operational limits and conditions, derived from tests, operational experience and the assessments as specified in Article 15 are defined and revised as necessary;

(iii) operation, maintenance, monitoring, inspection and testing of a radioactive waste management facility are conducted in accordance with established procedures. For a disposal facility the results thus obtained shall be used to verify and to review the validity of assumptions made and to update the assessments as specified in Article 15 for the period after closure;

(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a radioactive waste management facility;

(v) procedures for characterization and segregation of radioactive waste are applied;

(vi) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

(vii) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

(viii) decommissioning plans for a radioactive waste management facility other than a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body;

(ix) plans for the closure of a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility and are reviewed by the regulatory body.

ARTICLE 17. INSTITUTIONAL MEASURES AFTER CLOSURE

Each Contracting Party shall take the appropriate steps to ensure that after closure of a disposal facility:

(i) records of the location, design and inventory of that facility required by the regulatory body are preserved;

(ii) active or passive institutional controls such as monitoring or access restrictions are carried out, if required; and

(iii) if, during any period of active institutional control, an unplanned release of radioactive materials into the environment is detected, intervention measures are implemented, if necessary.

The general safety requirements of radioactive waste management are described in Section E.

H.1 Past practice

In Hungary, the significant use of open- and sealed sources of radioactivity began during the second half of the 1950s. Simultaneously with the domestic use of artificial radionuclides the disposal of the radioactive waste produced was regulated. In 1960 a temporary waste repository was set up just outside of Budapest at Solymár. Low level waste was stored in wells made of prefabricated concrete rings without backfilling. After the wells had become full they were covered with concrete.

As the site proved to be inadequate for long-term disposal (due to the unfavourable impermeable properties of the soil, the disadvantageous hydrogeology of the site, etc.), the waste was removed and the Solymár site was cleaned up and closed between 1979 and 1980. After that, environmental monitoring took place, and the authority then cleared the territory for limited utilisation.

Uranium mining started in Hungary in 1957 and was terminated in 1997. This past practice led to short-term remediation tasks and long-term tasks of environment protection and monitoring (for details, see Annex 7). The remediation of the uranium mine is in progress on the basis of a detailed and comprehensive plan, under the supervision of the regulatory authorities. The human and financial resources are assured by the Government for the long term.

H.2 Radioactive Waste Treatment and Disposal Facility

Assessment of safety and safety upgrading

In the course of the establishment of the facility, no comprehensive safety evaluation was carried out. Therefore, in the licensing process for extending the capacity of the repository in 1990, on the initiation of the Hungarian Geological Survey *taking part in the process*, only temporary operation licences were issued and safety assessments were to be carried out as required by the authority, *which were completed in 2000*.

Although the Radioactive Waste Treatment and Disposal Facility has been reliably operating for over 30 years, some waste types that were emplaced in it earlier *unfavourably influence the long term safety. The results of safety evaluations show that by disturbing the waste layer, the raising of certain sealed radioactive sources and long lived wastes may cause radiation exposures significantly exceeding the respective dose limits to both the intruders and some inhabitants in the vicinity of the repository.*

Therefore, in 2002 a *multi-stage programme* was launched with the aim at enhancing the safety and carrying out refurbishments. The first stage of the safety enhancement programme, approved in August 2002 by the minister disposing over the Central Nuclear Financial Fund, was terminated in 2005. At the same time the second stage – built on the results of the first, so-named preparatory stage – *was launched in 2006, the objectives of which are still as follows:*

- to make the repository safe for the period after institutional control;
- to carry out the refurbishments that are necessary to maintain safety;
- to make the repository suitable for the disposal of additional institutional waste.

The second stage of the safety improvement programme started with a demonstration programme, the results of which, and the relevant further plans, are described in Chapter K.2.

Refurbishment

The repository has been operated without any accident and the release of radioactive substances is well below the release limits. However, up till 2001 no investments for upgrading had been made in view of which the equipment has become obsolete and the physical condition of the operating systems has become impaired.

Between 2001 and 2004 the main areas of the upgrading activities were the following:

- physical protection (fence system, access control, *movement detector and aerial camera system* for the security guards);
- radiation protection (*application of electronic dosimeters, installation of radiation protection gates,* replacement of obsolete measurement devices, enhancement *of environmental monitoring laboratory*);
- data acquisition (*radiation protection remote control* system, *waste accounting system*, meteorological station);
- transportation (new transport vehicle and containers).

The list of repairs, improvements, and modernisation activities that have been carried out include: repair and refurbishment of the buildings; entire refurbishment of the electrical supply and the reserve electrical supply, of the water supply, the specialised sump water collection system, the ventilation system, and the decontamination facility; as well as upgrading of the fire-fighting system.

The other main objective of development at the repository site was to convert the technology building into a centralised interim store for institutional radioactive wastes which are not suitable for near-surface disposal (description of the repository is given in Annex 2).

During the preparation for the capping of vault row No. III, it was discovered that in the previous few years certain of the structures (gutters, asphalt surface, and concrete support) in the near vicinity of the vaults had deteriorated to a considerable extent due to the sinking of the soil under the road coverage, which may jeopardize *the subsequent final coverage* and possibly jeopardising the long term safety of the repository. In order to maintain safety on the long term a decision was made on the restoration of the vicinity of rows Nos. III and IV, which restoration was successfully completed without opening the vaults containing radioactive wastes (soil compacting, modernisation of rain water drainage system). Further consideration should be given to the eventual erosion of the surface, though it does not endanger at present and in the near future the safety of waste disposal. The extent of surface erosion is monitored continuously by measurements because, when closing down the repository, the safe capping method to be used will be selected based, among other factors, on the results of these measurements.

Between 2005 and 2008 the refurbishment of the repository was continued:

- a hot cell was installed in which radiation sources of up to 1 TBq ^{60}Co equivalent activity can be handled;
- a compactor with *a compression force of 500 kN* was put into operation; the volume reduction – depending on the waste composition – is 2-5;
- a sorting box destined for segregating the compactable and non-compactable waste was commissioned;
- purchasing and licensing of cementation equipment for the processing of *liquid* waste started in 2006;
- the firewater system and the rainwater drainage system were renewed;
- a cross-country vehicle was purchased to facilitate environmental sample-taking;
- a personal dosimeter system was developed to measure and record the neutron doses received by the workers.

Modernization that took place between 2008 and 2010 in parallel with safety improvement:

- *flocculating ion-exchanger system and the cement grout mixer used for cleaning and solidification of liquid radioactive wastes were commissioned;*
- *venting and extractor system was modified in accordance with new waste management technologies;*
- *the amortized communal sewage water store and garage building was replaced by a new structure and light construction building;*
- *chandeliers of the area enlightening and the insulation of precipitation water collectors were refurbished;*
- *the obsolete heating oil store and its valves used in the 1980s', having no further function, were demolished.*

H.3 Construction of National Radioactive Wastes Repository

After the development of an increased new disposal capacity, the Radioactive Waste Treatment and Disposal Facility is able to receive the radioactive wastes produced in research, medical and industrial institutions for several years, but for low and intermediate level waste coming from the operation and decommissioning of the nuclear power plant a new facility needs to be built.

Site selection process

The site selection process was directed by the Geological Institute of Hungary. Initially, in 1993, numerous potential locations were identified: 128 for near-surface and 193 for subsurface disposal. At this stage, another very important issue arose, namely the opinion of the population in the areas under consideration. Public approval was given to just a few dozen out of the potential areas.

Based on series of investigations in 1996, a granite formation in the village of Bátaapáti in south-west Hungary was selected as the site for the underground repository.

Safety analyses of the planned repository

In 2003 the geological investigations from the surface were completed. The geological authority stated that the site fulfilled all the requirements formulated in the relevant decree

[III.3], and that from the geological point of view; it is suitable for the disposal of low and intermediate level radioactive waste. Further investigations with a below-surface starting point were necessary to select the rock volume for the repository and its safety zone.

In 2004 a summarising safety assessment was completed with the goal of assessing the suitability of the Bátaapáti site utilising the most up-to-date techniques. The results verified the preliminary calculations with regard to the suitability of the site. Judging from the summarising safety assessment, the dose to the public caused by the planned repository will be by two – three orders of magnitude less than the dose constraint (100 μSv/year) for the public.

Preparing for the Environmental Impact Study, the environmental monitoring of the site has been continued.

By October 2004, the special authorities had issued every important license necessary for the excavation of inclined tunnels to carry out underground geological research activities. The goals of these research activities (within the granite formation declared as suitable) were aimed at defining the precise location of the repository. This research work *commenced in* February 2005 by way of two declined shafts.

In July 2005, on the initiative of the local government of Bátaapáti, a referendum was held in the village where – with a 75% participation rate – 90.7% of the eligible citizens were supportive concerning the implementation of the repository in the area of the village.

On 21 November 2005, the Hungarian Parliament approved a resolution on the preliminary approval, in principle, to initiate activities to prepare for establishing a radioactive waste repository.

In line with the underground activities the documents and plans necessary for licensing the repository were prepared. Based upon these the competent authority issued the environmental licence in 2007.

On the basis of the pre-commissioning safety assessment – prepared based upon the design documents and the environmental impact assessment – the competent authority issued the construction licence in 2008.

Eastern underground declined shaft of National Radioactive Waste Repository

Ongoing activities

The competent organization of the National Public Health and Medical Officer Service granted an operation license for the surface facility of the National Radioactive Waste Repository on 25 September 2008, which was renewed on 5 October 2010. Holding the licenses the first 16 barrels containing low and medium level radioactive waste were transported on 2 December 2008. Transports have been performed on a continuous basis since, and altogether 2400 barrels were in the technology building on 31 December 2010. In parallel with the operation of the surface facility the construction work of the sub-surface repository have been carried out in accordance with the construction license. The declined shafts leading to the repository and the service tunnels were accomplished. Additionally, at the beginning of 2011 the excavation of the first two repository chambers were started.

After the completion of two chambers the disposal of wastes into one of them can begin, while the other provides seismic shielding. In the future the construction of further chambers will take place in parallel with disposal of waste into the existing ones. In order to provide seismic safety one chamber must remain empty during the whole process between that being under construction and that where waste is being disposed of.

Technology hall of the National Radioactive Waste Repository

Repository concept and safety aspects

Construction and operation of the underground facility (including the transport of the radioactive waste to the disposal area) will make use of the two parallel inclined shafts used for underground geological research activities.

These shafts with a slope of -10% ensure access to the planned disposal depth (the “base” point). The two shafts are connected at each 220-270 m long section (by so called cross drifts), thereby ensuring the run through ventilation and the necessary escape routes.

Waste disposal will utilise a chamber- (gallery) type solution. The excavation of the one-exit chambers is executed from the connecting tunnel in a systematic arrangement, parallel to each other, and arranged in chamber-fields. For safety reasons the chambers are constructed in a single-level arrangement: this means that neither the chambers nor the chamber-fields integrating them into a unified system can cover each other.

Disposal of the various types of waste in the chambers will be performed in a segregated manner. National regulations require the retrievability of the waste packages during the operational period of the facility.

Section I. Transboundary Movement

ARTICLE 27. TRANSBOUNDARY MOVEMENT

1. *Each Contracting Party involved in transboundary movement shall take the appropriate steps to ensure that such movement is undertaken in a manner consistent with the provisions of this Convention and relevant binding international instruments.*

   In so doing:

   (i) a Contracting Party which is a State of origin shall take the appropriate steps to ensure that transboundary movement is authorized and takes place only with the prior notification and consent of the State of destination;

   (ii) transboundary movement through States of transit shall be subject to those international obligations which are relevant to the particular modes of transport utilized;

   (iii) a Contracting Party which is a State of destination shall consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the spent fuel or the radioactive waste in a manner consistent with this Convention;

   (iv) a Contracting Party which is a State of origin shall authorize a transboundary movement only if it can satisfy itself in accordance with the consent of the State of destination that the requirements of subparagraph (iii) are met prior to transboundary movement;

   (v) a Contracting Party which is a State of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this Article, unless an alternative safe arrangement can be made.

2. *A Contracting Party shall not licence the shipment of its spent fuel or radioactive waste to a destination south of latitude 60 degrees South for storage or disposal.*

3. *Nothing in this Convention prejudices or affects:*

   (i) the exercise, by ships and aircraft of all States, of maritime, river and air navigation rights and freedoms, as provided for in international law;

   (ii) rights of a Contracting Party to which radioactive waste is exported for processing to return, or provide for the return of, the radioactive waste and other products after treatment to the State of origin;

   (iii) the right of a Contracting Party to export its spent fuel for reprocessing;

   (iv) rights of a Contracting Party to which spent fuel is exported for reprocessing to return, or provide for the return of, radioactive waste and other products resulting from reprocessing operations to the State of origin

With regard to the transboundary movement of radioactive waste *and spent fuel*, Hungary promulgated in 2009 a governmental decree on the licensing of shipments of radioactive wastes *and spent fuel* across the national border. This *decree [II.29] implements regulation based on Council Directive 2006/117/Euratom of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel. As compared to former regulations one of the most important changes is the extension of the scope over spent fuel elements.*

The Hungarian Atomic Energy Authority is the competent body for licensing shipments of radioactive waste and spent fuel across Hungary and giving the necessary consent to licensing shipments if the licensing authority in the procedure is not the authority of Hungary. These undertakings are supported by the Headquarters of the Police, as special authority.

The *decree [II.29]* prohibits shipments from Hungary to any destination south of latitude 60° south and to any state being a contracting party of the African, Caribbean, Pacific country-group to the Agreement of Cotonou. No shipment shall be licensed if the country of destination does not have the technical, legal, or administrative resources to safely manage radioactive waste *and spent fuel*.

In compliance with Article 27 of the Convention, the Hungarian regulation does not prejudice or affect the rights of a contracting party as provided by international law, or with respect to the return of radioactive waste or other products from processing radioactive waste or reprocessing spent fuel.

Section J. Disused Sealed Sources

ARTICLE 28. DISUSED SEALED SOURCES

1. *Each Contracting Party shall, in the framework of its national law, take the appropriate steps to ensure that the possession, remanufacturing or disposal of disused sealed sources takes place in a safe manner.*
2. *A Contracting Party shall allow for reentry into its territory of disused sealed sources if, in the framework of its national law, it has accepted that they be returned to a manufacturer qualified to receive and possess the disused sealed sources.*

All practices involving radioactive materials, including sealed radioactive sources, are subject to licensing as required by the decree [III.9] of the minister responsible for health in order to ensure safety. All *sealed* radioactive sources are recorded in a central registry, operated by the Hungarian Atomic Energy Authority. *The Institute of Isotopes of the Hungarian Academy of Science assists the Hungarian Atomic Energy Authority in the establishment of conditions for authority control over radioactive materials (receipt, evaluation and computer processing of data supply).* The central registry system has been in operation since the end of the 1960s and it provides for the regulatory control of radioactive sources throughout their full life-time. This registration system was upgraded on the basis of the new decree *[III.19] of the minister supervising the HAEA in 2010*. The recent, unified computerised local and central registry system is based on regular electronic reports of inventory changes and annual inventories, and a passport identifying each sealed source that contains all relevant technical data as well as details of the owner of the source. The new system has strengthened the regulatory control, and greatly improved its efficiency.

One essential change introduced by the [III. 19] decree is a special regulation on radioactive wastes. It provides accountancy requirements for ensuring traceability as strict for sealed sources qualified as waste, as for sealed radioactive sources in use.

Legislation requires that unused radioactive sources be disposed of. The reporting system prescribed by the new regulation enables the regulatory authority to identify sources that have not been used for a longer period of time. Spent sources are disposed of at the Radioactive Waste Treatment and Disposal Facility at Püspökszilágy. The facility has sufficient space and infrastructure to handle the spent sources safely. The fees charged for disposal are sufficiently low in order to ensure that the lack of financial resources on the side of users should not be an obstacle to safe disposal. The accuracy of the regulatory accountancy for nuclear materials was enhanced by the elaboration of a method for determining the fissionable content of PuBe sources and by carrying out the measurements of about 100 such sources.

If requested, Hungarian manufacturers take back radioactive sources produced by them from users within the country or abroad. These sources are either re-manufactured or disposed of in the Radioactive Waste Treatment and Disposal Facility at Püspökszilágy. The legislative system does not prevent Hungarian manufacturers from fulfilling such obligations. In recent practice, numerous such obligations have been undertaken, and re-shipments take place regularly.

Section K. Planned Activities to Improve Safety

K.1 Interim Spent Fuel Storage Facility

The design work of the Interim Spent Fuel Storage Facility was performed in the 1990s, thus the facility is considered to be up to date. In view of this, safety enhancement measures affecting the operation of important systems are not required. With regard to the modifications of the existing systems of the facility, mention is made of the improvements to the physical protection, modernisation of the nitrogen gas supply system and leak-detection of the storage tubes, and the updated monitoring of the discharges and the environment. The container service reception building, the seismic support components of the refuelling machine and the radiation protection control system also have been improved too. The modifications facilitated the operation of the facility, thus they improved the operational safety.

The Interim Spent Fuel Storage Facility was being built up gradually and 11 modules were licensed for storage (operational licence) in 2004. After the fuel cleaning incident at Unit 2 of Paks NPP in 2003, the storage of hermetic, but surface contaminated fuel assemblies had to be solved. Based on the relevant safety evaluations, a licence was issued to store these fuel assemblies in the Interim Spent Fuel Storage Facility. The authority granted license for commissioning of the new modules 12-16 at the end of 2007.

Safety reassessment of nuclear facilities shall take place every 10 years. This Periodic Safety Review is required by the Act on Atomic Energy. At the beginning of 2008, in order to support the further operation of storage chambers 1-11 of the Interim Spent Fuel Storage Facility, PURAM submitted the respective Periodic Safety Review Report to the Hungarian Atomic Energy Authority.

Because the Hungarian Atomic Energy Authority decided to issue unified operation license for the modules 1-11 originally built and for the modules 12-16 constructed during the expansion, PURAM supplemented the unified Final Safety Analysis Report, which so became applicable to support the operation license of phase 2 and of each module.

In August 2008, based on the evaluation of the respective documentation the Hungarian Atomic Energy Authority extended the validity of operation license of waste receiving building and modules 1-16 of Spent Fuel Interim Storage Facility until 30 November 2018.

K.2 Radioactive Waste Treatment and Disposal Facility

From the results of the safety analysis it can be stated that operational and environmental safety up to the end of the passive institutional control of the Radioactive Waste Treatment and Disposal Facility at Püspökszilágy is appropriately guaranteed. The facility as a whole is suitable for the safe disposal of low and intermediate level short lived wastes.

Beyond passive institutional control, however, mostly because of the significant amount of long lived components already disposed of, inadvertent human intrusion - or any other scenario resulting in waste reaching the surface after the deterioration of the concrete barriers - could cause not only the dose constraint to be exceeded but even the dose limit.

Safety improvement programme was launched to address the problem, in the frame of which the demonstration programme referred to in Section H.2, planned the opening of four vaults. During sorting, the waste packages – based on the content of long-lived, alpha emitting nuclides – were separated into different categories and were treated and emplaced in different ways. Special attention was given to waste packages containing tritium or tritium sources. These latter were treated separately from the other wastes and they were encapsulated to prepare them for disposal.

The demonstration programme launched in 2006 was accomplished in 2009 by conditioning the most critical waste packages and re-disposal of complete waste packages. A summary evaluation completed the programme.

220 m^3 of waste was removed from the storage facility and then sorted. After conditioning and re-packaging the volume of the waste was 200 m^2. The volume of 20 m^3 gained is equal to the waste volume received during 2 years. Approximately one-third of the waste is long lived and will be stored in the interim storage facility. Approximately 650 radioactive sources were removed from the waste. The activity of the isotope inventory set up originally, and after re-qualification, differs only by one magnitude, which can be considered favourable if the uncertainty of the original inventory is taken into account.

Successful implementation of the demonstration programme has proven that it is feasible to remove and re-condition the waste with low employee doses, acceptable costs for a reasonable duration and by reaching appropriate qualification of the waste.

Based on the results of, and experience gained during, the demonstration programme the scope of the next period of safety improvement was determined by a safety analysis in 2010, and the respective licensing and implementation plans were developed accordingly. The safety improvement covers those vaults, in which a potential future inadvertent intruder would receive a dose ten times exceeding the dose limit and the dose avertable by a current intervention is higher than expected radiation exposure of employees performing the planned intervention. In addition, in order to gain storage volume by compacting, easily removable wastes will be removed from those vaults that do not have space filling.

The continuation of the safety improvement programme was permitted by the competent radiation health authority based on the plans submitted. The investment will continue with contractor selection and with the licensing of auxiliary installations. In line with the plans, re-conditioning of an additional 1000 m^3 of radioactive waste is expected in the mid-term.

Removal of special packages

Storage of re-packed wastes

ANNEXES

ANNEX 1:
THE INTERIM SPENT FUEL STORAGE FACILITY

An1.1 Description of the facility

The Interim Spent Fuel Storage Facility is a modular dry storage that can be functionally divided into three major structural units: the reception building, the charge hall, and the storage modules.

An1.1.1 The reception building

The first unit is the reception building in which the reception, preparation, and unloading of the spent fuel transfer casks takes place. This building comprises a reinforced concrete structure with a basement and a steel structure forming a hall. The fuel handling systems and the various auxiliary systems are installed in this building.

The reception building is a separate unit adjacent to the first module. It houses the equipment necessary to handle and position the transfer cask prior to fuel assembly removal and drying operations. The reception building also houses service and plant rooms, as well as ventilation systems and monitoring systems.

An1.1.2 The charge hall

The fuel handling machine performs the fuel transfer operations in the charge hall. The hall is bordered by the reinforced concrete wall of the ventilation stack on one side and by a steel structure with steel plate sheeting on the other side. The basic function of the sheeting is to protect the fuel handling machine against climatic stresses.

An1.1.3 The storage modules

The storage modules serve for the storage of the spent fuel. These modules are enclosed by thick reinforced concrete walls and shell structures filled with concrete; the basic function of these structures is to provide radiation shielding. *Each of the modules 1-16 is suitable for receiving 450 spent fuel assemblies. After the technological modifications each of the future modules will be suitable for storing 527 spent fuel assemblies.* They provide for the vertical dry storage of irradiated fuel assemblies, housing an array of steel fuel storage tubes each with a removable steel shield plug. Each fuel storage tube houses a single fuel assembly. Nitrogen *gas* is used in the tubes to provide an inert atmosphere. The reinforced concrete structure of the module is covered by a structural steel building to form the charge hall.

In the case of modules Nos. 1-11 the lifetime of the storing tube O-rings (until effective sealing is ensured) is expected to be longer than 25 years. In service the effectiveness of the sealing is checked by the monitoring system of the gas supply. Should gas from the nitrogen supply system of any of the modules escape due to corrosion or other reasons, an alarm will be set off. The threshold for the alarm is a gas leakage rate of 1.75 l/min.

Measurements utilising He-leak tests are carried out when filling the tubes with fuel assemblies as well as when leakage is observed.

In the case of the filled modules Nos. 1-11, every 5th year the sealing of 8 randomly selected closure plugs are removed and investigated by destructive material testing. As far as modules 12-16 are concerned, periodic inspection of the plugs is not needed as the rubber sealing was replaced by a metal one.

During the construction of the modules metal 'corrosion' samples were inserted into the modules in order to investigate the appropriateness of the surface protection – metal vaporization against corrosion – utilized for the storage tubes of the Interim Spent Fuel Storage Facility.

An1.2 Handling of fuel assemblies

A fuel handling machine moves the fuel assembly from a water-filled transfer cask to the fuel storage tube via a drying tube. The fuel handling machine operates in the charge hall.

An1.3 Cooling

The fuel stored in the metal tubes is cooled by the passage of air between the tubes, using the heat emitted from the stored fuel as the driving force.

Maximum temperature values:

fuel cladding:	410 °C
concrete:	100 °C
storage tube:	300 °C

During storage the temperature of the fuel cladding is not measured.

An1.4 Guarding

The site of the Interim Spent Fuel Storage Facility is situated in the immediate vicinity of Paks Nuclear Power Plant. Since 2004, the physical protection of nuclear facilities is ensured by an independent security organization (independent here means that it is not connected with the security body of the NPP) and by using state-of–the-art security systems meeting today's requirements.

The site can be accessed by persons and transports only with due authorization, under strict control of the security staff. Transport of the spent fuel assemblies of Paks NPP is carried out under strict control from one facility to the other via the transport gate.

An1.5 Radiation protection and environmental protection

Operational monitoring, sampling and the subsequent laboratory assessment of samples, and personal health physics monitoring are included in the radiation protection system of the Interim Spent Fuel Storage Facility.

The radiation protection monitoring system includes fixed dose rate measuring detectors and an aerosol monitoring network. In addition, various portable radiation protection devices are available for the operational staff. Personal radiation monitoring is performed with the use of film dosimeters, as required by the authorities, supplemented with thermo-luminescent detectors and electronic dosimeters.

The airborne discharge of the Interim Spent Fuel Storage Facility is monitored by an isokinetic sampling system and continuous aerosol monitoring equipment installed in the outlet stack of the ventilation system. The samples taken by the above equipment are subjected to total beta counting and gamma spectrometry analysis and, in addition, are assessed for ^{3}H, ^{14}C, ^{90}Sr and alpha activity-concentration. After assessing the samples taken from the tanks the liquid discharges of the storage are drained into the waste water system of the nuclear power plant. The discharges from the storage are very small: *in 2010 the amount of actual discharge was only 0.0154% of the derived limits.*

Since the site of the Interim Spent Fuel Storage Facility and that of the nuclear power plant are adjacent to each other, the environment monitoring system of the storage is integrated with that of the nuclear power plant. The entire network, together with the meteorological data obtained by the power plant's meteorological monitoring system, enables dispersion model calculations to be completed. The samples taken by the sampling station of the Interim Spent Fuel Storage Facility are processed and assessed in the environmental monitoring laboratory of the nuclear power plant.

Until now, the environmental monitoring system has not shown any increment of the dose to the population living in the vicinity of the site. The impact can be estimated only if based on calculations using discharge data. Up to now, the excess dose calculated for the critical group of the population from emission data *was less than 3 nSv/year*; in other words, orders of magnitude less than the dose constraint (10 μSv/year).

ANNEX 2:

THE RADIOACTIVE WASTE TREATMENT AND DISPOSAL FACILITY

The Radioactive Waste Treatment and Disposal Facility is located at Püspökszilágy, on the ridge of a hill at an altitude of 200-250 m above sea level. One side of the hill is steep with a slope length of 200-250 m, whereas the other side is longer and slopes more gently. The groundwater depth is 14 to 16 metres measured from below the bottom of the storage vaults and wells. The facility occupies a surface area of 10 hectares.

An2.1 Description of the facility

The repository is of a near-surface type which consists of reinforced concrete vaults and storage wells. The vaults and the storage wells are located above the water table in the unsaturated zone within Quaternary clayey loess, which is approximately 30 m thick at the repository location and overlies a thick Tertiary (Upper Oligocene) sequence.

The repository is divided into *more* areas in order that different types of wastes can be stored or disposed of separately. Vaults designated as ‘A-type’ serve for disposal of radioactive waste; vaults designated as ‘C’-type’ and the storage wells (designated as ‘B’ and ‘D’) are used for storage. *Also the “AT” interim storage halls, “ATCS” storage tube wells and the nuclear material store located in the acceptance building including waste management technologies are used for storage.*

The ‘A-type’ vault system contains 60 vaults each of 70 m^3 and 6 vaults each of 140 m^3. Most of the vaults are only partially backfilled. After reaching capacity, two vault rows were temporarily covered *with soil*. The final cap is to be produced only after the safety enhancement measures have been completed.

In 2004 the ‘A-type’ vaults containing the solid wastes reached capacity, therefore further waste shipments can only be placed in the interim storage area in the cellar of the technology building. This temporary solution – by which the continuity of reception of institutional radioactive wastes from all over the country can be secured – is to be applied until free storage capacity is provided by recovery of the waste from the designated vaults followed by segregation and, if possible, volume reduction as well as the reconstruction of the vaults.

The ‘C-type’ vaults were used to store contaminated organic solvents whose activities were higher than the limit acceptable for incineration. Prior to emplacement the liquid wastes were solidified or soaked up by diatomaceous earth at the place of generation. These wastes were usually placed in the storage position in metal cans or metal drums.

This storage system consists of 8 vaults, each of 1.5 m^3, sunk into the ground. The inner walls of the vaults are covered by a waterproof layer.

There are 16 wells of ‘B’ type with a diameter of 40 mm, and 16 wells with diameters of 100 mm. The wells are made from stainless steel; they are 6 m deep, located inside a monolithic concrete structure. The wells of greater diameter accommodate the by-products from the production of ^{60}Co sources. The radiation sources containing ^{192}Ir are separated from other sealed sources. *Out of the six meter depth of the well, 5 m is the effective depth to provide effective radiation protection at ground level. During service the wells are protected by lead plugs.*

The type 'D' storage unit consists of four carbon-steel wells, each one is 6 m deep and has a diameter of 200 mm. They can be locked and are provided with a protective cap. These wells were utilised for storing spent radiation sources with a half-life of greater than 5 years. One of the wells are used for interim storage of very long lived sealed radioactive sources. These wells were also filled up by now.

The total underground portion of the so-named service building hosting waste management technologies is an interim storage place, which ensures the long term interim storage of low and intermediate level, long lived radioactive wastes. It is also puffer storage of short lived wastes, while freeing of storage capacity is going on in the type "A" vault. The interim storage contains two halls, which are capable of storing more than 900 waste barrels. The barrels are arranged in fours in a support frame. Additional cubic plate containers of 1.2 m^3 volume are used to store wastes, which occupy the area of just a support frame. In the interim storage facility, storage area was established to retrievably store sealed radioactive sources. The storage area further consists of 50 tubes of 4 m depth and of 40-100-200 mm diameter. Storage of nuclear materials takes place in separate compartments.

An2.2 Handling and Storage

Review of waste acceptance requirements and their adjustment to the new waste management technologies took place in 2010. Licensing of the new requirements is in progress.

In the past, the used sealed radioactive sources were not conditioned before placement to type "B" and "D" stainless steel vaults. Currently the sealed radioactive sources are placed in a metal capsule in the hot chamber and sealed by welding, and then they are put into type "B" vaults or tubes for interim storage. The metal capsule can be grasped at its head and lowered into, or raised from, the tube well.

The unsealed radioactive sources are either handled as are the sealed ones, or disposed of along with the other low and intermediate level radioactive wastes after cementing. The compressible wastes are compressed by a 500 kN force press. Wastes requiring conditioning (e.g. solidified waste waters, organic liquids, bodies of experimental animals, salts, wastes of powder content, ion exchanger resins etc.) are primarily embedded into cement by using accessory materials with a specified mixing ratio. The uncompressible and conditioned wastes are disposed of in barrels of 200 l or plate containers of 1.2 m^3, the internal spaces in the packages are filled with cement grout.

Collection, selection, treatment and packaging of wastes takes place at the ground level of the so-named service building by way of a assorting chamber, hot chamber, press, waste water treatment and cementing device. Subsequent to its packaging the waste is qualified administratively or by measurement, and then compared to activity limits of disposal requirements. Based on the qualification it is decided whether the particular waste package can finally be disposed of in type "A" vaults or will be stored in one of the interim storage places.

Since 1998, those radioactive wastes containing thorium, uranium and plutonium isotopes as well as disused plutonium sources collected from the country's institutions have been stored in the nuclear material store. *Since 2005 the source containers made of depleted uranium are accepted in this repository.*

An2.3 Transport, disposal and record keeping

The transport of radioactive waste to be disposed of or stored in the facility from waste generator to site and on-site is organised by PURAM under its own responsibility, using its own work force and equipment (transport vehicles, containers). *Radioactive sources and radioactive waste are transported in accordance with ADR regulations*.

Before transportation the used radioactive sources are packed in aluminium or polythene casing and then disposed of in a lead container. Paraffin/danamid protection is applied for neutron sources as necessary. Other wastes are transported in metal drums to the facility. Large gamma sources are usually sealed into a special disposal container by the Institute of Isotopes Ltd.

If treatment is required prior to disposal *or interim storage to meet the respective requirements*, then the waste is conditioned. The types of waste needing treatment include organic solvents, biological waste, contaminated water, damaged or damageable spent sources. Treatment may be by solidification, sponging up of liquid by absorbing material, or by repackaging.

The Hungarian regulatory system requires all licensees working with radioactive materials to maintain local registries of all radioactive materials in their possession. As one of the licensees, the Radioactive Waste Treatment and Disposal Facility operates a *radioactive sources and waste registry system*.

In accordance with the regulations, the Radioactive Waste Treatment and Disposal Facility reports detailed data on the disposal of sealed spent sources to the central registry, and also submits to the registry annual reports on the volume and radionuclide inventory of bulk waste disposed of.

An2.4 Guarding

A new access control and defence system, was installed in 2001 as part of the refurbishment programme. The site is guarded by armed security guards, applying up-to-date security systems. The access control system ensures that only authorized persons and shipments have access to the site and can stay there. The system provides for the identification and computer based registration of accessing persons. Access to the site is possible only through the access point of the security system, in a controlled manner.

An2.5 Radiation protection and environmental protection

Personal dosimetry control is the task of the Radiation Protection Service of the Radioactive Waste Treatment and Disposal Facility and takes place according to the respective regulation [III.9]. Normal operation of the facility and the waste transports typically cause 0-2 mSv/year radiation dose for the employees.

Surface contamination of transport vehicles, employees and instruments are inspected in every case by manual devices during treatment, transportation and maintenance or repairs. Surface contamination has never been detected on the external surface of vehicles. Accidents or radioactive release have never taken place during transportation of radioactive wastes.

A remote controlled radiation protection monitoring system is operated within the radiation controlled area of the site. The typical average value of background gamma dose-rate on the site of the facility is around the natural background value: 70 – 130 nSv/h.

Environmental monitoring is an organic part of the radiation protection monitoring system of the Radioactive Waste Treatment and Disposal Facility. Measurement samples are taken from the whole area of the site and its 20 km vicinity with regard to the surface water flows.

The so-named pre-commissioning base level was determined at the most important locations in the vicinity of the facility, which is referred to as the pre-commissioning background level. The measurement results produced in line with the annual programme approved by the radiation health authority are compared to those values determined in 1976-77.

Ecology survey having been performed since 2003 involves soil sampling, plant sampling and animal origin sampling, as well as local measurements on the site of the facility.

The monitoring system was extended in 1992 by a hydrology monitoring system (ground water level, stream flow rate) and by a system regularly measuring the downhill movement. The meteorology station and soil erosion examinations also support data collection required for safety analysis.

An annual report is prepared for the authority describing the radiation protection and environmental monitoring activity. The authority inspects the operation of the plant twice a year by administrative instruments and measurement of environmental samples.

The annual amount of tritium released from the facility to the soil humidity via diffusion and from there to the atmosphere or to the ground water under the disposal facility is taken into account by theoretical calculation in support of release analysis. Since the geological formation hosting the facility has very favourable hydrological characteristics from the aspect of radioactive waste disposal and the movement of ground water is very slow, thus the tritium accumulated in the body of ground water under the facility during the years of operation (within the controlled zone) is measurable. According to measurements even the direct consumption of the ground water under the facility would not cause radiation exposure above the dose restrictions, and so complies with the limit defined by the World Health Organization for drinking water.

Based on the measurement results of the monitoring system the emissions from the facility are negligible, the activity of direct releases to atmospheric and water environment is 0.5% of the annual limit.

Radioactivity of the environment of the facility shows fluctuation as compared to the base level values measured in 1976-77, but has not increased. The radiation exposure to the public from the operation of the disposal facility, which is unmeasureable, can be at most 0.5 μSv/year based on release data.

ANNEX 3:
ISOTOPE COMPOSITION OF LLW/ILW

In Hungary, the inventory of radioactive waste - as described in Section D - consists of *three* major components:

- the waste disposed of in the Radioactive Waste Treatment and Disposal Facility;
- the radioactive waste temporarily stored in Paks Nuclear Power Plant;
- the radioactive waste stored in the technological store of the National Radioactive Waste Repository.

The quantity of waste temporarily stored at small-scale waste producers is negligible from the point of view of the overall national inventory. This Annex gives detailed data on the isotope composition of LLW/ILW in the above mentioned three facilities.

An3.1 Radioactive Waste Treatment and Disposal Facility

The following table contains the estimated activity of main isotopes, important for safety, in the inventory of the Radioactive Waste Treatment and Disposal Facility as of 31 December 2010. Isotopes with a half-lifetime of less than 5 years are not included.

Table An3.1-1 Isotope composition of the waste disposed of in the Radioactive Waste Treatment and Disposal Facility (Bq)

Isotope	*Sealed radioactive sources*		*Waste*		*Total*
	Final disposal	*Interim storage*	*Final disposal*	*Interim storage*	
^{3}H	8.48E+13	2.02E+12	5.63E+12	3.73E+13	1.30E+14
^{14}C	1.00E+10	2.35E+08	7.29E+11	3.17E+12	3.91E+12
^{60}Co	2.18E+11	2.86E+14	2.60E+09	3.58E+11	2.87E+14
^{85}Kr	6.38E+10	6.33E+10	3.92E+10	5.52E+10	2.21E+11
^{90}Sr	2.64E+13	3.88E+11	5.12E+09	2.65E+12	2.95E+13
$^{99}Tc/^{99m}Tc$	1.89E+11	3.40E+06	1.17E+04	1.85E+08	1.89E+11
^{137}Cs	4.43E+12	9.71E+12	1.25E+10	8.46E+10	1.42E+13
^{226}Ra	4.75E+09	2.23E+11	3.07E+10	7.21E+10	3.31E+11
^{226}Ra-Be	2.19E+10	1.44E+11			1.65E+11
^{232}Th	2.03E+06		1.10E+10	3.79E+10	4.88E+10
^{234}U	6.90E+08		1.48E+06		6.91E+08
^{235}U	1.34E+06	2.39E+02	5.00E+07	1.15E+07	6.28E+07
^{238}U	1.50E+08	1.05E+06	3.96E+09	2.25E+10	2.66E+10
^{238}Pu	1.23E+10	1.23E+10		1.15E+07	2.46E+10
^{238}Pu-Be	4.36E+11	3.72E+11		1.63E+06	8.08E+11
^{239}Pu	1.06E+10	1.70E+09	2.26E+09	1.39E+12	1.40E+12
^{239}Pu-Be		4.55E+12			4.55E+12
^{241}Am	1.27E+12	1.07E+12	7.37E+08	3.22E+10	2.37E+12
^{241}Am-Be	2.49E+12	8.64E+12	3.48E+11		1.15E+13

Notes:

1. *In the case of technetium generators registered in the accounting system in the past, probably the (initial) activity of ^{99}Mo was specified, and thus was entered into the database without correction, as the activity of ^{99}Tc. 89% of the activity belongs to ^{99m}Tc.*
2. *In comparison to the data of former reports, in addition to radioactive decay and recent transports, it also has to be taken into account that, during 2007-2009 280 m^3 of formerly disposed waste was re-selected, during which the sealed radioactive sources and long lived materials were removed from the wastes and placed in interim stores. Wastes were re-qualified during re-selection, so significant changes took place in the activity of tritium and uranium isotopes.*
3. *In the past reports the isotopes were grouped according to the type of stores containing them (”vaults” and ”wells”). In order to better comply with the international regulation the grouping has been performed in this report according to sealed/unsealed sources along with interim storage/final disposal.*

An3.2 Paks Nuclear Power Plant

Table An3*.2-1 summarises activity of radioisotopes of low and intermediate level solid and liquid wastes of Paks NPP (evaporation residue, ion exchanger resin) on 31 December 2010.*

Table An3.2-1 Activity of low and intermediate level waste of Paks Nuclear Power Plant by isotopes calculated for 31 December 2010 (Bq)

Isotope	Solid waste	Liquid waste	Sum
^{3}H	1.10E+11	6.86E+11	7.96E+11
^{14}C	1.30E+12	4.30E+11	1.73E+12
^{36}Cl	1.85E+05	1.58E+08	1.59E+08
^{41}Ca	6.54E+04	4.01E+07	4.02E+07
^{51}Cr	3.20E+06	N.A.	3.20E+06
^{54}Mn	1.33E+10	9.10E+08	1.42E+10
^{55}Fe	4.93E+09	5.13E+13	5.13E+13
^{58}Co	4.57E+08	2.50E+07	4.82E+08
^{59}Fe	2.11E+07	9.04E+05	2.20E+07
^{59}Ni	2.80E+09	2.95E+10	3.23E+10
^{60}Co	2.19E+11	1.22E+12	1.44E+12
^{63}Ni	1.52E+11	1.06E+12	1.21E+12
^{90}Sr	6.11E+08	2.39E+14	2.39E+14
^{94}Nb	N.A.	2.38E+08	2.38E+08
^{95}Nb	4.34E+06	N.A.	4.34E+06
^{95}Zr	2.83E+07	N.A.	2.83E+07
^{99}Tc	6.08E+06	5.48E+10	5.48E+10
^{103}Ru	6.32E+03	N.A.	6.32E+03

Isotope	Solid waste	Liquid waste	Sum
^{106}Ru	9.01E+09	N.A.	9.01E+09
^{110m}Ag	1.43E+09	3.35E+09	4.78E+09
^{124}Sb	2.19E+07	5.53E+06	2.74E+07
^{125}Sb	6.57E+08	N.A.	6.57E+08
^{129}I	3.85E+04	5.16E+06	5.20E+06
^{134}Cs	3.21E+09	5.65E+13	5.65E+13
^{137}Cs	2.21E+10	3.70E+14	3.70E+14
^{141}Ce	1.76E+02	0.00E+00	1.76E+02
^{144}Ce	1.69E+09	0.00E+00	1.69E+09
^{238}Pu	2.97E+07	1.70E+13	1.70E+13
^{239}Pu+ ^{240}Pu	2.61E+07	4.11E+12	4.11E+12
^{234}U	3.07E+05	2.15E+10	2.15E+10
^{235}U	3.98E+04	2.68E+08	2.68E+08
^{238}U	1.71E+05	1.11E+09	1.11E+09
^{241}Am	7.07E+06	4.16E+12	4.16E+12
^{242}Cm	1.84E+07	1.11E+09	1.13E+09
^{244}Cm	5.14E+07	1.51E+13	1.51E+13

Notes: *N.A.: no data available*

Table An3.2-2 Volume and total activity of wastes resulting from the incident in Paks NPP Unit 2 calculated for the end of the original design lifetime (Bq)

Isotope	***Solid*** ***400 m³***	***Concentrate*** ***310 m³***	***Resin*** ***60 m³***
^{124}Sb	2.21E-17	1.61E-15	2.17E-14
^{58}Co	1.27E-11	9.23E-10	1.25E-08
^{242}Cm	3.05E+00	6.45E+02	2.75E+03
^{110m}Ag	1.09E+03	4.40E+04	1.07E+06
^{54}Mn	1.53E+05	1.11E+07	1.50E+08
^{134}Cs	7.72E+08	1.65E+10	7.71E+11
^{55}Fe	1.06E+09	7.73E+10	1.04E+12
^{60}Co	1.16E+09	8.45E+10	1.14E+12
^{3}H	9.61E+07	8.01E+10	1.60E+10
^{244}Cm	1.00E+08	2.12E+10	9.03E+10
^{90}Sr	7.44E+02	3.01E+04	7.29E+05
^{137}Cs	5.81E+10	1.24E+12	5.80E+13
^{238}Pu	5.09E+08	1.07E+11	4.58E+11
^{63}Ni	6.55E+08	4.76E+10	6.42E+11
^{241}Am	2.71E+08	5.72E+10	2.44E+11
^{14}C	2.76E+06	3.04E+08	2.48E+09
^{243}Am	2.50E+06	5.27E+08	2.25E+09
^{94}Nb	6.29E+06	4.57E+08	6.17E+09
$^{239+240}Pu$	5.24E+08	1.11E+11	4.73E+11
^{59}Ni	8.26E+06	6.00E+08	8.09E+09
^{41}Ca	3.45E+03	1.04E+05	3.38E+06
^{99}Tc	2.35E+02	4.71E+03	2.31E+05
^{234}U	1.67E+06	3.52E+08	1.50E+09
^{36}Cl	4.66E+04	4.66E+06	4.20E+07
^{135}Cs	3.02E+05	6.44E+06	3.01E+08
^{129}I	2.17E+04	2.17E+05	2.15E+07
^{235}U	4.75E+04	1.00E+07	4.27E+07
^{238}U	3.36E+05	7.10E+07	3.03E+08

Table An3.2-3 contains the activity of certain radioisotopes which are important for safety assessments. These were calculated from the average activity concentrations in the various waste streams and the quantity of wastes expected by the end of the originally designed service life of the nuclear power plant (2017).

Table An3.2-3 Estimated activity of certain radioisotopes by the end of the originally designed lifetime of Paks NPP (Bq)

Isotope	*Solid*	*Concentrate*	*Resin*	*Sum*
^{124}Sb	8.45E+08	1.56E+09	N.A.	2.40E+09
^{58}Co	1.81E+10	1.73E+11	1.23E+10	2.03E+11
^{110m}Ag	2.18E+10	9.01E+10	7.68E+11	8.80E+11
^{54}Mn	3.17E+10	1.03E+11	9.00E+11	1.03E+12
^{134}Cs	1.70E+09	2.02E+11	3.32E+11	5.35E+11
^{55}Fe	1.76E+12	3.17E+11	5.61E+13	5.81E+13
^{60}Co	3.38E+11	1.03E+12	6.15E+11	1.98E+12
^{3}H	N.A.	4.77E+11	7.52E+10	5.53E+11
^{244}Cm	4.07E+04	2.99E+08	5.52E+07	3.54E+08
^{90}Sr	2.32E+05	1.28E+10	2.48E+11	2.61E+11
^{137}Cs	1.68E+10	2.85E+12	2.85E+12	5.71E+12
^{238}Pu	1.08E+05	2.05E+08	1.55E+08	3.60E+08
^{63}Ni	4.12E+10	5.92E+11	2.79E+11	9.12E+11
^{241}Am	2.58E+05	1.92E+08	3.77E+07	2.30E+08
^{14}C	4.07E+10	2.46E+10	3.01E+11	3.66E+11
^{243}Am	N.A.	1.96E+05	5.61E+04	2.52E+05
^{94}Nb	4.62E+08	6.80E+07	1.19E+07	5.42E+08
$^{239+240}Pu$	1.50E+05	1.73E+08	8.43E+06	1.81E+08
^{59}Ni	4.62E+08	2.39E+10	3.25E+10	5.68E+10
^{41}Ca	1.50E+05	4.30E+07	1.19E+09	1.23E+09
^{99}Tc	2.72E+06	3.04E+07	3.70E+08	4.03E+08
^{234}U	1.03E+04	1.01E+06	5.93E+06	6.95E+06
^{36}Cl	5.71E+04	9.97E+06	8.43E+07	9.43E+07
^{135}Cs	6.53E+04	1.66E+07	1.79E+07	3.45E+07
^{129}I	2.99E+03	2.33E+08	9.15E+07	3.24E+08
^{235}U	2.28E+03	2.65E+05	2.08E+06	2.35E+06
^{238}U	7.34E+03	7.70E+05	3.97E+06	4.74E+06

Note:
N.A.: No data available

The data presented in Table An3.2-3 is based on the quantities as follows.

	Up to 31 December 2001	From 2002 to 2017
- solid waste:	120 m^3/year	160 m^3/year
- concentrate:	250 m^3/year	250 m^3/year
- resin:	2.5 m^3/year	5 m^3/year

The solid low level waste that was transported to the Radioactive Waste Treatment and Disposal Facility is not included in the quantities. The effects of the planned liquid waste treatment technology are not taken into account. Wastes arising from decommissioning are not taken into account.

An3.3 National Radioactive Waste Repository

2,400 barrels containing low level solidified and compressed radioactive waste were stored in the surface technological storage facility of the Bátaapáti National Radioactive Waste Repository until 31 December 2010. The activity of the total amount of low and intermediate level waste stored in the technological storage facility by isotopes calculated for 31 December 2010 is shown in Table M3.3-1.

Table An3.3-1 Isotope composition of waste stored in the National Radioactive Waste Repository

Isotope	Activity (Bq)	Isotope	Activity (Bq)
^{110m}Ag	6.41E+08	^{129}I	2.69E+03
^{241}Am	3.08E+05	^{54}Mn	3.57E+09
^{140}Ba	2.85E+03	^{95}Nb	1.72E+05
^{14}C	2.72E+05	^{59}Ni	4.32E+08
^{41}Ca	5.42E+03	^{63}Ni	2.33E+10
^{36}Cl	5.03E+04	^{238}Pu	1.91E+05
^{242}Cm	2.38E+04	^{239}Pu	1.75E+05
^{244}Cm	2.48E+05	^{124}Sb	1.58E+06
^{58}Co	3.45E+07	^{90}Sr	7.95E+06
^{60}Co	4.82E+10	^{99}Tc	1.16E+06
^{51}Cr	1.43E+05	^{234}U	3.25E+04
^{134}Cs	1.85E+08	^{235}U	3.61E+03
^{137}Cs	2.88E+09	^{238}U	2.31E+04
^{55}Fe	1.28E+09	^{65}Zn	1.07E+06
^{59}Fe	5.03E+05	^{95}Zr	5.30E+05
^{3}H	2.78E+10		

ANNEX 4:
LIST OF LAWS RELEVANT TO THE CONVENTION

Acts, Law-decrees

I.1	Law-decree 12 of 1970	on the promulgation of the treaty on non-proliferation of nuclear weapons resolved by Session No. XXII. of the General Assembly of the United Nations Organisation on the 12th of June in 1968
I.2	Act IV of 1978	concerning the Penal Code
I.3	Law-decree 8 of 1987	on the promulgation of the convention on physical protection of nuclear materials
I.4	Act XXXVIII of 1992	concerning the state budget
I.5	Act LIII of 1995	on the general rules for the protection of the environment
I.6	Act CXVI of 1996	on atomic energy
I.7	Act I of 1997	on the promulgation of the Convention on Nuclear Safety concluded in Vienna on the 20th of September in 1994 under the umbrella of the International Atomic Energy Authority
I.8	Act CLVI of 1997	on non-profit organizations
I.9	Act L of 1999	on the confirmation by the Republic of Hungary and on the promulgation of the Comprehensive Test-ban Treaty resolved by the General Assembly of the United Nations Organisation on the 10th of September in 1996
I.10	*Act LXXIV of 1999*	*on the management and organization for the protection against disasters, and on the protection against severe accidents involving dangerous materials*
I.11	Act LXXVI of 2001	on the promulgation of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management concluded under the International Atomic Energy Agency
I.12	Act CXL of 2004	on the general rules of regulatory procedures and services in the public administration
I.13	Act IV. of 2006	on business associations
I.14	Act LXXXII of 2006	on the promulgation of the safeguards agreement and protocol in the implementation of Article III(1) and (4) of the Treaty on the Non-Proliferation of Nuclear weapons, and on the promulgation of the Additional Protocol, enclosed with the agreement

Governmental decrees, decrees of the Council of Ministers

II.1	Decree of the Council of Ministers 28/1987. (VIII. 9.)	on the promulgation of the convention on early notification of a nuclear accident signed in Vienna on the 26th of September in 1986
II.2	Decree of the Council of Ministers 29/1987. (VIII. 9.)	on the promulgation of the convention on assistance in the case of a nuclear accident or radiological emergency, signed in Vienna on the 26th of September in 1986
II.3	Decree of the Council of Ministers 70/1987. (XII. 10.)	on the promulgation of the agreement on regulation of mutually interesting questions relating to nuclear facilities concluded between the Government of the Hungarian People's Republic and the Government of the Austrian Republic, signed in Vienna on the 29th of April in 1987
II.4	Decree of the Council of Ministers 93/1989. (VIII. 22.)	on the promulgation of the Reviewed Complementary Agreement on the technical assistance of the International Atomic Energy Agency to Hungary concluded between the Government of the Hungarian People's Republic and the International Atomic Energy Agency, signed on the 12th of June in 1989
II.5	Decree of the Council of Ministers 24/1990. (II. 7.)	on the promulgation of the international convention on civil liability for nuclear damage concluded in Vienna on the 21st of May in 1963
II.6	Governmental Decree 73/1991. (VI. 10.)	on the promulgation of the agreement on regulation of mutually interesting questions relating to nuclear safety and radiation protection between the Government of the Republic of Hungary and the Government of the German Federal Republic, signed in Budapest on the 26th of September in 1990
II.7	Governmental Decree 108/1991. (VIII. 28.)	on the promulgation of the agreement on mutual information and co-operation in the field of nuclear safety and radiation protection between the Government of the Republic of Hungary and the Government of the Czech and Slovak Federal Republic, signed in Vienna on the 20th of September in 1990
II.8	Governmental Decree 130/1992. (IX. 3.)	on the promulgation of the joint record of the application of the Vienna Convention on civil liability for nuclear damage, and the application of the Paris Convention on the civil liability in the field of nuclear energy, signed on the 20th of September in 1989
II.9	Governmental Decree 17/1996. (I. 31.)	on the actions in connection with the found or confiscated radioactive or nuclear materials
II.10	Governmental Decree 124/1997. (VII. 18.)	on radioactive materials as well as equipment generating ionising radiation, exempted from the scope of the Atomic Energy Act CXVI of 1996.
II.11	Governmental Decree 185/1997. (X. 31.)	on the promulgation of the agreement on the early notification in the case of radiological emergency concluded between the Government of the Republic of Hungary and the Government of the Republic of Slovenia, signed in Budapest on the 11th of July in 1995
II.12	Governmental Decree 213/1997. (XII. 1.)	on the exclusion zone of the nuclear facility and the radioactive waste repository

II.13	Governmental Decree 227/1997. (XII. 10.)	on the type, conditions and sum of the liability insurance or other liability financial coverage concerning nuclear damage
II.14	Governmental Decree 240/1997. (XII. 18.)	on the establishment of the organisation designated for implementing the disposal of radioactive waste and spent fuel, as well as decommissioning of nuclear facilities, and on the financial source for performing such tasks
II.15	Governmental Decree 61/1998. (III. 31.)	on the promulgation of the agreement on the early notification in the case of nuclear accidents concluded between the Government of the Republic of Hungary and the Government of Romania, signed in Bucharest on the 26th of May in 1997
II.16	Governmental Decree 108/1999. (VII. 7.)	on the promulgation of the agreement on the early notification in the case of nuclear accidents, and on the mutual information and co-operation in the field of nuclear safety and radiation protection, concluded between the Government of the Republic of Hungary and the Government of Ukraine, signed in Budapest on the 12th of November in 1997
II.17	Governmental Decree 13/2000. (II. 11.)	on the promulgation of the agreement on the early notification in the case of radiological accidents concluded between the Government of the Republic of Hungary and the Government of the Republic of Croatia, signed in Zagreb on the 11th of June in 1999
II.18	Governmental Decree 72/2000. (V. 19.)	on the special conditions of acquiring the possession rights of certain materials, equipment and facilities belonging in the scope of application of atomic energy, as well as on the procedure for reporting their possession and operation
II.19	Governmental Decree 136/2002. (VI. 24.)	on the promulgation of the agreement on cooperation in the field of the peaceful use of atomic energy between the Government of the Republic of Hungary and the Government of Australia
II.20	Governmental Decree 275/2002. (XII. 21.)	on the monitoring of radiation levels and radioactivity concentrations in Hungary
II.21	Governmental Decree 114/2003. (VII. 29.)	on the duties, scope of authority and the jurisdiction of imposing penalties of the Hungarian Atomic Energy Authority, and on the activity of the Atomic Energy Co-ordination Council
II.22	Governmental Decree 165/2003. (X. 18.)	on the information to be provided to the public in nuclear and radiological emergencies
II.23	Governmental Decree 244/2004. (VIII. 25.)	on the promulgation of the protocol signed by the Government of the Republic of Hungary and the Government of the Russian Federation on conditions concerning the reshipment to the Russian Federation of Russian-made (irradiated) spent fuel assemblies
II.24	Governmental Decree 263/2004. (IX. 23.)	on the regulation of international trade of nuclear and nuclear dual-use items

II.25	Governmental Decree 89/2005. (V. 5.)	on the nuclear safety requirements of nuclear facilities and the related regulatory activities
	Annex No. 1 Nuclear Safety Code Volume 1	Regulatory procedures for nuclear power plants
	Annex No. 2 Nuclear Safety Code Volume 2	Quality management of nuclear power plants
	Annex No. 3 Nuclear Safety Code Volume 3	Design requirements for nuclear power plants
	Annex No. 4 Nuclear Safety Code Volume 4	Safety requirements for the operation of nuclear power plants
	Annex No. 5 Nuclear Safety Code Volume 5	Nuclear safety code for research reactors
	Annex No. 6 Nuclear Safety Code Volume 6	Nuclear safety code for spent fuel interim storage facilities
II.26	Governmental Decree 314/2005. (XII. 25.)	on environmental impact assessment and on the integrated environmental usage permitting process
II.27	Governmental Decree 257/2006. (XII. 15.)	on declaring the outstanding importance of certain administrative regulatory matters in connection with the project of a repository of low and intermediate activity, to be established in Bátaapáti
II.28	Governmental Decree 267/2006. (XII. 20.)	on the Hungarian Office for Mining and Geology
II.29	*Governmental Decree 34/2009. (II. 20.) Korm.*	*on licensing of transboundary movement of radioactive waste and spent fuel*
II.30	*Governmental Decree 167/2010. (V. 11.) Korm.*	*on the National Nuclear Emergency Response System*
II.31	*Governmental Decree 323/2010. (XII. 27.)*	*on the National Public Health and Medical Officer Service, fulfilment of public health administration tasks and on the designation of the administrative body of pharmaceutics*

Ministerial Decrees

III.1	Decree of the Minister of Transportation and Post 20/1979. (IX. 18.)	on the promulgation and inland application of Appendixes "A" and "B" of the European Agreement about the International Public Road Transportation of Dangerous Goods
III.2	Decree of the Minister of the Interior 47/1997. (VIII. 26.)	on the tasks of the police in connection with the application of atomic energy
III.3	Decree of the Minister of Industry, Trade and Tourism 62/1997. (IX. 26.)	on the geological and mining requirements for the siting and planning of nuclear facilities and radioactive waste disposal facilities
III.4	Decree of the Minister of Transportation, Telecommunica-tion and Water 13/1997. (IX. 3.)	on the promulgation of the regulation on the safe railway transportation of spent nuclear fuel
III.5	Decree of the Minister of Transportation, Telecommunica-tion and Water 14/1997. (IX. 3.)	on the transportation, shipment and packaging of radioactive materials
III.6	Decree of the Minister of Public Welfare 23/1997. (VII. 18.)	on the exemption levels (activity-concentrations and activities) of radionuclides
III.7	Joint Decree of the Minister of Industry, Trade and Tourism and the Minister of Education 49/1998. (VI. 25.)	on the professional training and further education of those employed at the nuclear power plant, or at the research reactor, or at the training reactor, and on those who are entitled to pursue activities connected with the application of nuclear energy
III.8	Decree of the Minister of Economy 27/1999. (VI. 4.)	on the fees for final disposal of radioactive wastes
III.9	Decree of the Minister of Health 16/2000. (VI. 8.)	on the execution of certain provisions of Act CXVI of 1996 on Atomic Energy associated with radiation protection
III.10	Decree of the Minister of Health 30/2001. (X. 3.)	on the operational radiation protection of the outside workers
III.11	Decree of the Minister of Health 31/2001. (X. 3.)	on the protection of the health of individuals exposed to ionising radiation during medical services
III.12	Decree of the Minister of Environment 15/2001. (VI. 6.)	on the radioactive releases into the air and into the water in connection with the application of atomic energy, and on their control
III.13	Decree of the Minister of Health 8/2002. (III. 12.)	on the establishment and operation of radiological monitoring and data collecting network in the health-care sector
III.14	Decree of the Minister of Defence 33/2002. (V. 3.)	on the application of Act CXVI of 1996 on Atomic Energy regarding national defence issues
III.15	Decree of the Minister of Health, Social and Family Affairs 47/2003. (VIII. 8.)	on certain issues of interim storage and final disposal of radioactive wastes, and on certain radiohygiene issues of naturally occurring radioactive materials concentrating during industrial activity
III.16	Decree of the Minister of Justice 14/2005. (VII.25)	on the operation and administration of the Central Nuclear Financial Fund
III.17	Decree of the Minister of Justice and Law Enforcement 7/2007. (III. 6.)	on the rules of accountancy for and control of nuclear materials
III.18	*Decree of the Minister of Transportation, Communication and Energy 38/2009. (VIII. 7.) KHEM*	*on the inland application of the annexes of European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)*

III.19	*Decree of the Minister of Transportation, Communication and Energy 11/2010. (III.4.) KHEM*	*on the order of registration and inspection of radioactive materials and related data supply*

IV. Government Resolutions

IV.1	Government Resolution 2161/1994. (XII. 30.) Korm.	on uranium mining
IV.2	Government Resolution 2085/1997. (IV. 3.) Korm.	on discontinuing uranium mining in the Mecsek hills
IV.3	Government Resolution 2385/1997. (XI. 26.) Korm.	on the investment programme of the remediation tasks for the abandonment of the uranium industry in Hungary
IV.4	Government Resolution 2006/2001. (I. 17.) Korm.	on the modification of governmental resolution 2085/1997. (IV. 3.) on discontinuing uranium mining in the Mecsek Hills, and of governmental resolution 2385/1997. (XI. 26.) on the investment programme of the remediation tasks for the abandonment of uranium mining in Hungary
IV.5	Government Resolution 2122/2006. (VII. 11.) Korm.	on further tasks related to the abandonment of uranium mining in Hungary

ANNEX 5:

REFERENCES TO OFFICIAL NATIONAL AND INTERNATIONAL REPORTS RELATED TO SAFETY

An5.1 Report to *Government and* Parliament on the safety of nuclear applications in Hungary

The Act on Atomic Energy [I.6] obliges the Hungarian Atomic Energy Authority to submit an annual report to the Government and Parliament on the safety of nuclear applications in Hungary.

In preparing the report, the Hungarian Atomic Energy Authority is supported by the other regulatory authorities competent in nuclear applications. The report is subject to intergovernmental discussion and the Government decides on its presentation to Parliament.

The annual report describes the manifold activities related to the safety of the nuclear facilities as well as to the safety of applications of radioactive and nuclear materials and devices emitting ionising radiation. The report consists of the following main chapters:

- Use of atomic energy;
- State-level framework of safety;
- *Safety* of nuclear facilities;
- *Safety and security* of nuclear and radioactive materials;
- *Safety of disposal of radioactive wastes;*
- Supervision of radiation safety and radiation protection;
- Nuclear emergency preparedness;
- Scientific-technical background;
- International relations;
- Hungary`s role in the European Union;
- Public relations.

The reports for the years 2007 and 2009, similarly to the previous reports, concluded that the nuclear applications in Hungary fulfil the relevant safety requirements.

An5.2 National Report prepared in the framework of the Convention on Nuclear Safety

Hungary is a Party to the Convention on Nuclear Safety and prepared a National Report on the fulfilment of the obligations contained in this Convention in 1998, in 2001, in 2004, *in 2007 and in 2010*. The Reports were favourably taken up in the review meetings. The reports are available on the homepage of the Hungarian Atomic Energy Authority (www.haea.gov.hu).

An5.3 Participation in the reporting schemes of the IAEA

Hungary, as a Member State of the International Atomic Energy Agency, takes part in the international systems (Incident Reporting System-IRS, and International Nuclear Event Scale-INES) for exchanging information on safety related events. In applying INES, the national INES co-ordinator reports all safety-related events above the level INES 0 to the International Atomic Energy Agency.

Since 2000 this obligation is extended to the Interim Spent Fuel Storage Facility, but in this facility, corresponding to the favourable operational experience, no events took place, which were to be reported in the framework of IRS or INES.

ANNEX 6:

REFERENCES TO REPORTS ON INTERNATIONAL REVIEW MISSIONS PERFORMED AT THE REQUEST OF HUNGARY

An6.1 IRRS mission at the Hungarian Atomic Energy Authority

Expert teams of the International Atomic Energy Agency visited the Hungarian Atomic Energy Authority already twice (in 2000 and 2003), at the request of the Hungarian Government authorities, to conduct a mission. In each case, the purpose of the mission was to review the effectiveness of the activity of Hungarian nuclear safety regulatory body and to exchange information and experience in the regulation of nuclear, radioactive waste and radiation safety.

In 2010 preparatory actions were commenced for the next review. The international review organized by the International Atomic Energy Agency takes place now in the framework of the International Regulatory Review Sevice (IRRS). The experts of the International Atomic Energy Agency held a three-day training about the use of software supporting self-assessment (Self-Assessment Tool; SAT). In 2011 the implementation of the self-assessment project started.

An6.2 Review of remediation of impact area of the former uranium ore mine and ore processing facility in the Mecsek Hills

The director-general of the Hungarian Atomic Energy Authority invited the International Atomic Energy Agency, at the beginning of 2010, to review the remediation of impact area of the former uranium ore mine and ore processing facility in the Mecsek hills, managed by MECSEK-ÖKO Zrt.. MECSEK-ÖKO Zrt. initiated the audit, to verify the harmony of the remediation work performed and the subsequent so-named "long term activity" with the recommendations, requirements of the International Atomic Energy Agency, based on which the safe performance of future environmental protection related works may also be guaranteed.

The International Atomic Energy Agency compiled a team of internationally acknowledged and experienced scientists in the field of remediation works to review the activities. The experts of various member states of the Agency visited MECSEK-ÖKO Zrt. between December 13-17, 2010. The team reviewed the results achieved by the company, the actual works, the regulatory environment and the financial background of the project based upon a detailed task plan.

The report prepared, based upon the audit, contains the detailed description of the remediation activity and "long term activity" (water treatment, environmental monitoring, maintenance and post-treatment of remediated areas) performed by MECSEK-ÖKO Zrt., including the Hungarian legal background and the elements of regulatory oversight of the activity. Moreover, the report contains the comments and recommendations of the experts with the aim of enhancing the long term, and safe, performance of the activities.

In the preliminary report (the development of the final report was in progress when this National Report was drawn up) the international team placed emphasis upon the professional maintenance and operation of the facilities, and determined that the practice applied at MECSEK-ÖKO Zrt. is in harmony with the international standards and requirements. The experts performing the audit also found place for further improvement and confirmed that the treatment of surface and underground waters should be treated probably for decades to protect the drinking water tables They suggested to develop a strategy plan for a 30 year period, which would appropriately manage the uncertainties time-to-time appear in regard to the financial and human resources required for the activities, and would make more effective the use of the resources.

ANNEX 7:

THE REMEDIATION OF THE CLOSED URANIUM MINE AND LONG TERM ACTIVITY AFTER TERMINATION OF THE URANIUM ORE MINING

An7.1 Antecedents

Six mining plots were established during the operation of the underground and surface facilities of Hungarian uranium ore mining and milling. These plots are located to the west of the city of Pécs, on the western and southern sides of the Mecsek Hills.

Because uranium mining became uneconomical in the 1980s, the Government decided that it should be discontinued. Production was terminated in 1997. In accordance with the decision, an investment plan was developed for the remediation of the environmental damage caused by Hungarian uranium ore mining and milling. The implementation of the plan commenced on 1 January 1998 in compliance with government resolutions [IV.1] and [IV.2].

Remediation tasks were carried out according to plan until the end of 2002. However, since 2003 the funds allocated by the government in its annual budget acts have been insufficient to allow the completion of work by the planned deadline. The investment was completed in accordance with government resolution [IV.5] on subsequent tasks related to the abandonment of uranium ore mining in Hungary. The resolution set a new deadline for the completion of the remediation activities, this being 31 December 2008. Also, the budget of the remediation project has been increased from HUF 19.1 to HUF 20.7 milliard.

An7.2 Environmental remediation programme

An7.2.1 Primary remediation objectives

The remediation objectives to be achieved were specified in the concept plan developed in 1996:

- eliminating or minimising the environmental damage caused by uranium ore mining;
- re-utilising the areas and facilities of the uranium industry to the optimum extent;
- defining the costs of both the cessation of uranium ore production and environmental remediation;
- implementing the concept plan in a cost-effective and appropriately scheduled way.

An7.2.2 Radiation protection requirements

Relevant Hungarian as well as international laws and standards, the recommendations of the International Atomic Energy Agency, and the practices of other countries play an important role in setting out requirements. The authorities laid down the environmental protection conditions of the planning and licensing process of decommissioning and remediation activities in the environmental protection licence *and in its amendment in 2007* issued by the South Transdanubian Environmental Protection Inspectorate.

The following limit values for the release and environmental load have to be complied with in the course of mine closure and remediation projects according to the environmental protection licence and the specifications of the Baranya County Institute of National Public Health Medical Officer Service.

Table An7.2.2-1 Radiation protection *limits* for the remediation of waste rock piles, heap leaching piles and tailings ponds

Rn exhalation	0.74 Bq/m^2/s
Rn concentration	background + 30 Bq/m^3
Gamma-dose rate	background + 200 nGy/h
Activity concentration of soil in the uppermost 0-15 cm layer in the next 15 cm layer	 background + 180 Bq/kg background + 550 Bq/kg

Table An7.2.2-2 Radiation protection *limits* for the remediation of surface facilities, buildings and their immediate surroundings

Surface facilities	Rn exhalation	0.74 Bq/m^2/s
	Activity concentration of soil in the uppermost 15 cm layer	background + 180 Bq/kg
	Activity concentration of soil below 15 cm depth	background + 550 Bq/kg
Inside buildings	Rn concentration	1000 Bq/m^3
	Gamma-dose rate workplace average 1 m from floor or walls	 background + 200 nGy/h background + 200 nGy/h
	Fixed alpha contamination (on floor and walls)	0.5 Bq/cm^2

Note on Tables An7.2.2-1 and An7.2.2-2: the limit for radon concentration was changed by the relevant authority in 2007. The environmental protection licence permits only limited use of the buildings: utilisation as living space, as a facility for children, or for foodstuff production is not permitted.

Table An7.2.2-3 Background radiation of natural origin in the areas affected by uranium ore mining in Mecsek hills

Parameter	***Background value***
Rn concentration in open space	*12 Bq/m^3*
Gamma dose rate	*250 nGy/h*
Activity concentration of soil	*180 Bq/kg*

An7.2.3 *Features* of the remediation programme

The determination of the size of mining objects was a basic requirement for the execution of remediation tasks in the planned manner. The characteristic features of the main objects and facilities on the mining plots and other sites are the following:

- volume of underground openings $17.9{*}10^{6}\ m^{3}$
- volume of the nine waste rock piles $10{*}10^{6}\ m^{3}$
- volume of the two heap leaching piles $3.4{*}10^{6}\ m^{3}$
- contaminated industrial area 62 ha
- volume of the two tailings ponds $16.2{*}10^{6}\ m^{3}$

Air shaft IV of the uranium ore mine during operation and after remediation

An7.2.4 An overview of the remediation tasks of the Investment Programme

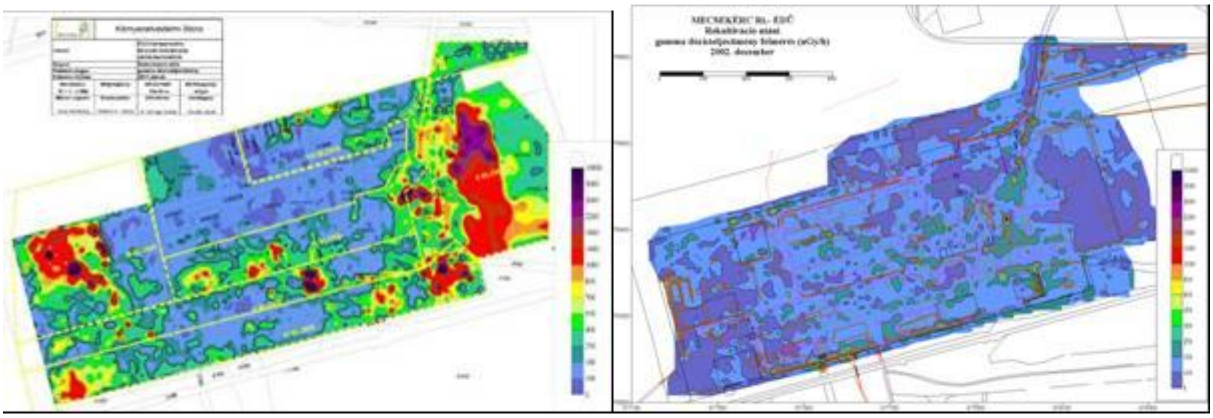
The Investment Programme consisted of ten projects. The schedule of the programme is shown in Table An7.2.4-1.

Table An7.2.4-1 Schedule of the remediation programme

Project title	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Underground mines											
Surface facilities											
Waste rock piles											
Heap leaching piles											
Tailings ponds											

Project title	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Mine water treatment											
Restructuring of electricity supply											
Water supply and sewage											
Infrastructure works											
Monitoring, misc. activities											

The remediation programme, aimed at the elimination of environmental impacts of uranium ore mining and processing conducted in the Mecsek hills, was successfully accomplished in 2008. During the activity, in addition to the abandonment of the underground mine areas, the remediation of surface facilities (sludge stores, dumps, percolation spaces, service areas) took place as a result of which the direct danger of contamination of surface and underground waters and the environment was eliminated.



Gamma dose measurement rates results in the Ore Enrichment Plant site before and after the remediation

The website of MECSEK-ÖKO Zrt, the company in charge of the remediation project, provides the public with information on the solutions and achievements in the fields of remediation, landscaping, water treatment, and monitoring.

An7.3 Post-remediation tasks

The "Investment Programme of the remediation tasks of the abandonment of the uranium mining in Hungary" approved by a government resolution [IV.3] included the costs of the so-named long-term tasks (water purification, maintenance, monitoring activities) until 31 December 2002. Since these tasks *are still existing* for environmental, health and water reserve protection reasons, a new government resolution [IV.4] was made to provide for the financing of these tasks as of 1 January 2003. Under the resolution the funds must be earmarked in the budget of the Ministry of Transport, Telecommunication and Energy in a format agreed to by the Ministry of Environment

Protection and Water Management. *After the reorganization of the ministries, this task appeared in the budget of the Ministry of National Development.*

For the long-term success of technical interventions made for the purposes of environmental protection and reclamation according to the plans of the Investment Programme and meeting official requirements, controlling, monitoring and maintenance tasks are to be performed. These tasks vary in terms of their scale, character and length of time in the case of each object.

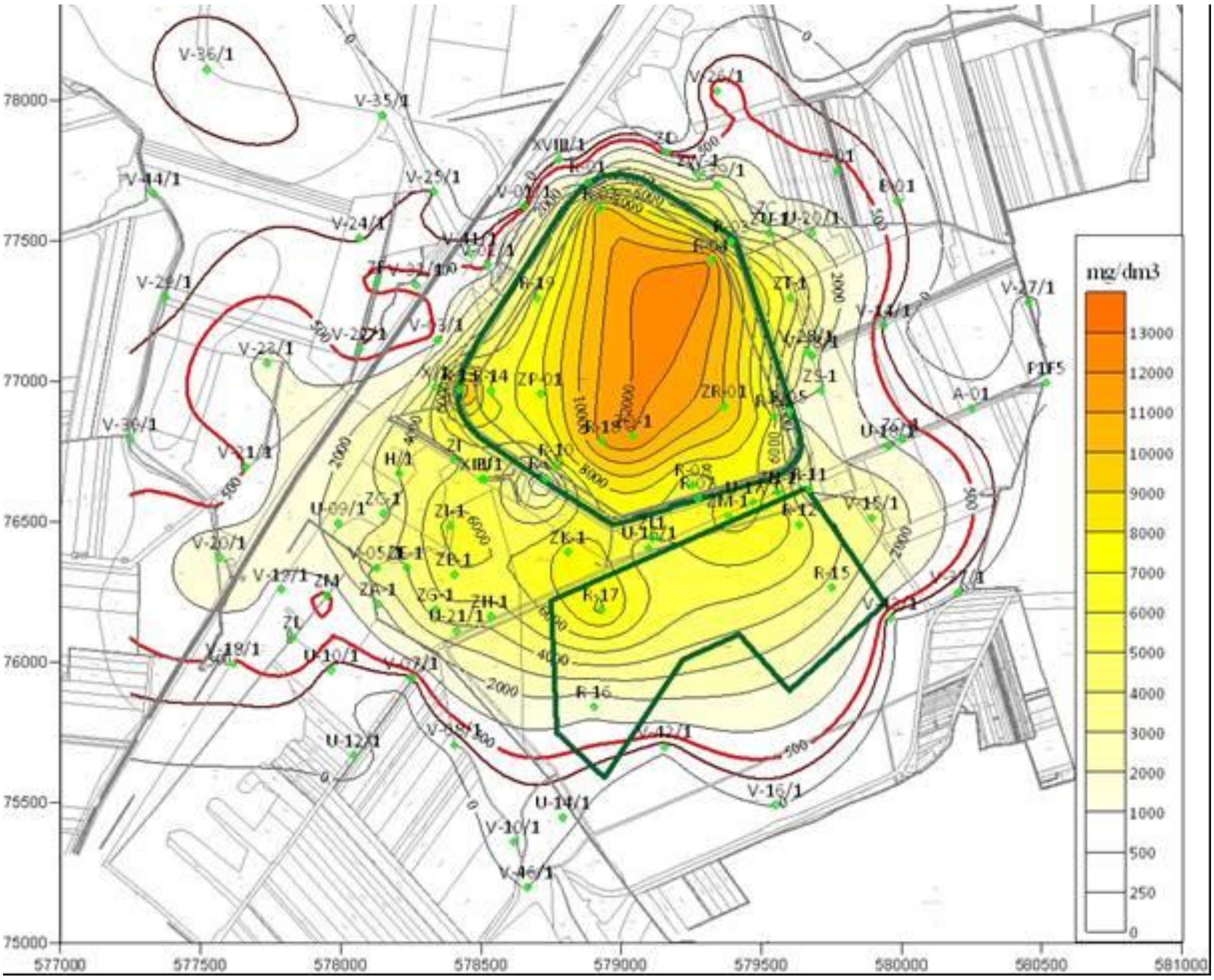
In accordance with the methodology accepted internationally in the field of remediation, the execution of these tasks are divided into two phases with regard to the amount and character of the required activities:

- the first five-year phase generally involves a broad and diverse range of control activities as well as more intensive after-care procedures;
- the second, long-term phase involves only limited control and after-care procedures as and when needed.

The following long-term tasks have to be performed in the interest of environmental protection:

- removal of uranium from surface and groundwaters (the capacity of the water treatment station is 1.5 million m^3 annually);
- groundwater treatment (treatment of *an average* water volume of 1000-1200 m^3/day, *however, due to the wet weather in 2010, the treatment of a much larger volume was needed*);
- maintenance of water treatment stations, decontamination and water discharging systems;
- operation of the unified water discharge system;
- maintenance and after-care of areas of limited utilisation.

Considerable after-care activities *have to be* performed on the tailings ponds, which are the largest and most sensitive objects due to the complexity of the cover layer. To protect the drinking water reserve, the sulphate-containing water that seeped into the soil from the tailings ponds is removed and treated chemically.



Sulphate content of ground water in the vicinity of sludge stores in 2010 (mg/dm^3) (green colour is used to delimit the area of the two sludge stores)

Remedied uranium industry sludge store

The environmental audit of mining remediation took place in 2006. The audit established that remediation works had been carried out according to the originally approved program, and the area of a number of former facilities may now be utilised without any restriction. It also found that the radiological exposure of the public had decreased as the area of contaminated surfaces in direct contact with air had significantly decreased. *In accordance with the recommendations given in the amendment of the environmental license, the optimization of the operation of the damage elimination system took place taking into account the results of transport modelling of contaminants in order to being able to assess the effectiveness and to prognose the expected duration of intervention in the surroundings of the tailings ponds.*

ANNEX 8: NUCLEAR FACILITIES, SPENT FUEL ASSEMBLIES, DISCHARGES

An8.1 Paks Nuclear Power Plant

An8.1.1 Management of the spent fuel assemblies

Regulatory framework

The design and implementation of systems and management for spent fuel assemblies as well as the development of handling processes were accomplished according to the Soviet norms that were in effect at the time of constructing the Paks Nuclear Power Plant as were the requirements promulgated by a decree in force at that time. Legal and technological changes taking place in the meantime made it necessary to renew this regulation. The Government of the Republic of Hungary, based on the authorization given in the Act on Atomic Energy [I.6], issued the governmental decree on the proceedings of the Hungarian Atomic Energy Authority [II.25]. As appendices of this decree, the Nuclear Safety Codes were issued replacing the above mentioned Safety Regulations for Nuclear Power Plants.

Systems managing spent fuel elements

Storage of spent fuel assemblies

Spent fuel generated during operation of the nuclear power plant need to be stored prior to any potential further processing or direct disposal. The basic function of the storage in the vicinity of the reactor – with limited capacity – is to ensure the storage during the period until the specific activity and heat generation of the spent fuel assemblies diminish to a level that enables its transport from the plant.

In the case of Paks Nuclear Power Plant, the storage at the reactor is ensured under water, in the spent fuel (cooling) pond located in the near vicinity of the reactor. An independent spent fuel pond belongs to each of the four reactors.

In the spent fuel ponds belonging to the individual blocks the spent fuels can be stored at two levels. The storage “rack” of high density grid structure ensuring the operational storage is located at the bottom of the spent fuel pond, it can be used for storing the spent operational fuel elements, control rods, followers and hermetic claddings. The storage of high density grid distribution is built from tubes of neutron–absorbing materials with a pitch of 160 mm. The material of the absorbing tubes is stainless steel with 1.05 – 1.25% boron content ensuring sub-criticality. The airtight sealed claddings are for storing fuel assemblies that became inhermetic during operation.

Handling and transport equipment of spent fuel assemblies

The handling equipment of spent fuel assemblies is used to move the fuel assemblies, burnt out in the reactors, during refuelling and - if necessary – to check them as well as to prepare for their transport out of the plant after the decay period in the spent fuel ponds.

The design basis of tools and equipment for handling of fuel assemblies ensures the removal of decay heat, the maintaining of sub-criticality, the radiation protection of the personnel and the minimization of possible injures during operation.

Removal of the decay heat

In order to ensure the proper cooling of fuel assemblies the temperature of the water in the spent fuel pond must not exceed 60 °C; therefore two parallel cooling circuits serve the cooling of the spent fuel ponds.

Proper cooling for fuel assemblies placed in transport containers is guaranteed by the design of the container as well as the limitation of the minimum cooling time and the highest burn-up for assemblies to be transported. During preparations for transporting the spent fuel with C–30 containers, based on the safety assessment performed for the container, the following limiting conditions shall be kept (one part of them explicitly serves the safe removal of the decay heat):

a) highest initial enrichment: 4.2%;
b) 54 GWday/tU highest fuel burn-up;
c) maximum four-year fuel cycle;
d) maximum 15 kW total output;
e) minimum 0.5 year decay time.

Criticality safety

Verification of sub-criticality for fuel storage systems is based on model calculations. The assessments were accomplished for storage filled with radially profiled fresh fuel elements of 3.82% average enrichment, containing 120.2 kg uranium. *Before the introduction of the new fuel assemblies containing 126.3 kg uranium of 4.2% average enrichment and gadolinium as burning poison the calculations were repeated.* Thus, sub-criticality of fuel elements stored in the spent fuel pond is ensured by the design/construction of the storage racks. The storage racks filled up in compliance with the requirement keep the sub-critical state even if they are flooded with clean, i.e. boron-free, water.

Other risks taken into account

- The dropping or any other kind of damage to the fuel assemblies, or the development of unacceptable mechanical stresses are minimized by the transport and lifting technology equipment (with bayonet joint grip, retainers and cranes of prescribed safety factor) and storage technologies.
- The seismic safety revision and the necessary strengthening of Paks Nuclear Power Plant have been accomplished. Ensuing from the low frequency of fuel handling manipulations, no seismic event of SL-2 level was assumed simultaneously with re-fuelling and transport manipulations (in case of Paks NPP this is defined by 0.25g ground surface acceleration and a site-specific response spectrum).
- Evaluations of immunity against external dangers were accomplished for facility level; thus, the extent of risk could not be determined specifically for tools and equipment for handling nuclear fuel. As a whole, however, the facility – and the handling of nuclear fuel included – could be seen as protected against external danger.

- Fire risk assessments accomplished for Paks NPP did not indicate any significant risk in connection with the fuel element handling processes.

Compliance with the fuel cycle strategy

From the tasks related to managing the spent fuel, Paks NPP performs independently, in its own competence, only the interim storage in the spent fuel ponds. Maximum storage capacity of the spent fuel ponds amounts to 1052 assemblies for each unit. Spent fuel elements – after a decay period of at least 3 years – are handed over for a further intermediate storage of about 50 years in the Interim Spent Fuel Storage Facility. (*See chapter B.1.2*)

Consequences of the incident of April 2003

The incident on 11 April 2003 at Unit 2 of Paks NPP and the recovery work performed to remove the consequences of the incident are described in detail in the fourth National Report of Hungary prepared in the framework of the Convention on Nuclear Safety in 2007. This National Report is available on the web site of the Hungarian Atomic Energy Agency (www.haea.gov.hu).

The fuel assemblies damaged during the incident in the so-named Pit No. 1 were loaded into canisters designed for storing fragments of fissile materials. The canisters were designed for a minimum of five years storage in the spent fuel pond. The encapsulation work was finished in early 2007. The loaded 68 canisters have been stored in the spent fuel pond.

An8.1.2 Discharges

Regulatory framework

The constraint for the additional dose resulting from the operation of the nuclear power plant to the critical group of the population is 90 μSv/year, according to the regulation in force since 1998. The relevant decree [III.12] provided for isotope selective limits derived from dose constraints. The new discharge limits for the various discharge modes and isotopes were approved by the authorities in 2004. Based on it, Paks NPP has calculated - for all relevant discharge pathways and all important isotopes - the annual discharge limit values that are derived from the dose constraint according to the following formula:

$$EL_{ij} = \frac{DL}{DE_{ij}},$$

where

EL_{ij}: is the discharge limit for radionuclide “i” with respect to discharge pathway “j” (Bq/year);

DL: is the dose constraint (Sv/year);

DE_{ij}: is the contribution of a unit discharge of radionuclide “i” in discharge pathway “j” to the annual dose (Sv/Bq).

In order to comply with the regulatory restriction, decree [III.12] states that the order, methods and means of the discharge monitoring, as well as features of their capability and effectiveness shall be specified in a Discharge Monitoring Code in order to determine the quantity of radioactive materials discharged into the environment. Furthermore, this document specifies that the discharge monitoring of radioactive materials shall be supplemented with measurements performed in the environment, and the order, methods and means of these monitoring activities, as well as features of their capability and effectiveness shall be also specified in the Discharge Monitoring Code.

Systems for discharge monitoring

The system of operational and regulatory monitoring, as well as the measuring methods were planned and established in Paks Nuclear Power Plant so that (a) full monitoring of all planned discharge routes, as well as the revealing of possible non-planned discharge of the radioactive materials into the environment are ensured; furthermore, (b) so that it is possible to track the spreading of radioactive materials discharged, and - if it is possible - to forecast it and finally to estimate and evaluate the radiation exposure of the population. *The refurbishment of the system, designed in the 1970s, was completed in 2005.*

The discharge monitoring of radioactive materials, as well as the radiological monitoring of the plant's environment is based partly on remote measuring (telemetric) systems and on sampling laboratory tests. The data gained from the discharge- and environment monitoring remote measuring systems, as well as from the data of the meteorological tower are collected and archived in a central computer.

Airborne discharges

The monitoring of the airborne discharges is based on the continuous operation isokinetic sampler installed in the chimney before the discharge point. In addition to laboratory sampling, the changes are checked by two parallel, independent monitoring systems. The monitoring system consists of three sub-units which are continuously sampling and measuring the discharge of aerosol, iodine (I-131) and noble gas. The measuring range of the measuring units is the following:

Aerosol	gross β:	$1 - 1x10^6$	Bq/m^3
	gross α:	$1x10^{-2} - 1x10^4$	Bq/m^3
Noble gas	gross β:	$1x10^2 - 4x10^9$	Bq/m^3
Radioiodine (^{131}I)	γ:	$1 - 1x10^6$	Bq/m^3

In parallel to the monitoring units, a continuous gamma-spectrometric system is available which performs isotope-selective measurement of the noble gas discharge. Laboratory sampler units serve for isotope-selective measurement of the atmospheric discharge in accordance with the chemical forms.

Liquid discharges

Sampling of radioactive liquid discharges is performed from monitoring tanks. The qualitative and quantitative determination of the radio-isotopes existing in the waste waters and generated during operation of the nuclear power plant is executed by means of laboratory analysis of the samples taken from the tanks. Only the waste water in the tank that has been already analysed and has a valid discharge licence is allowed to be discharged into the environment through the specified discharge route.

Detectors equipped with a protective pipe are placed into the meter pits with an overflow sill along the discharge pipeline. By measuring the gross gamma activity concentration of the flowing liquid medium (water), it is possible to monitor continuously the extent of its radioactive contamination. The measuring range is $1 – 10^9$ Bq/m^3.

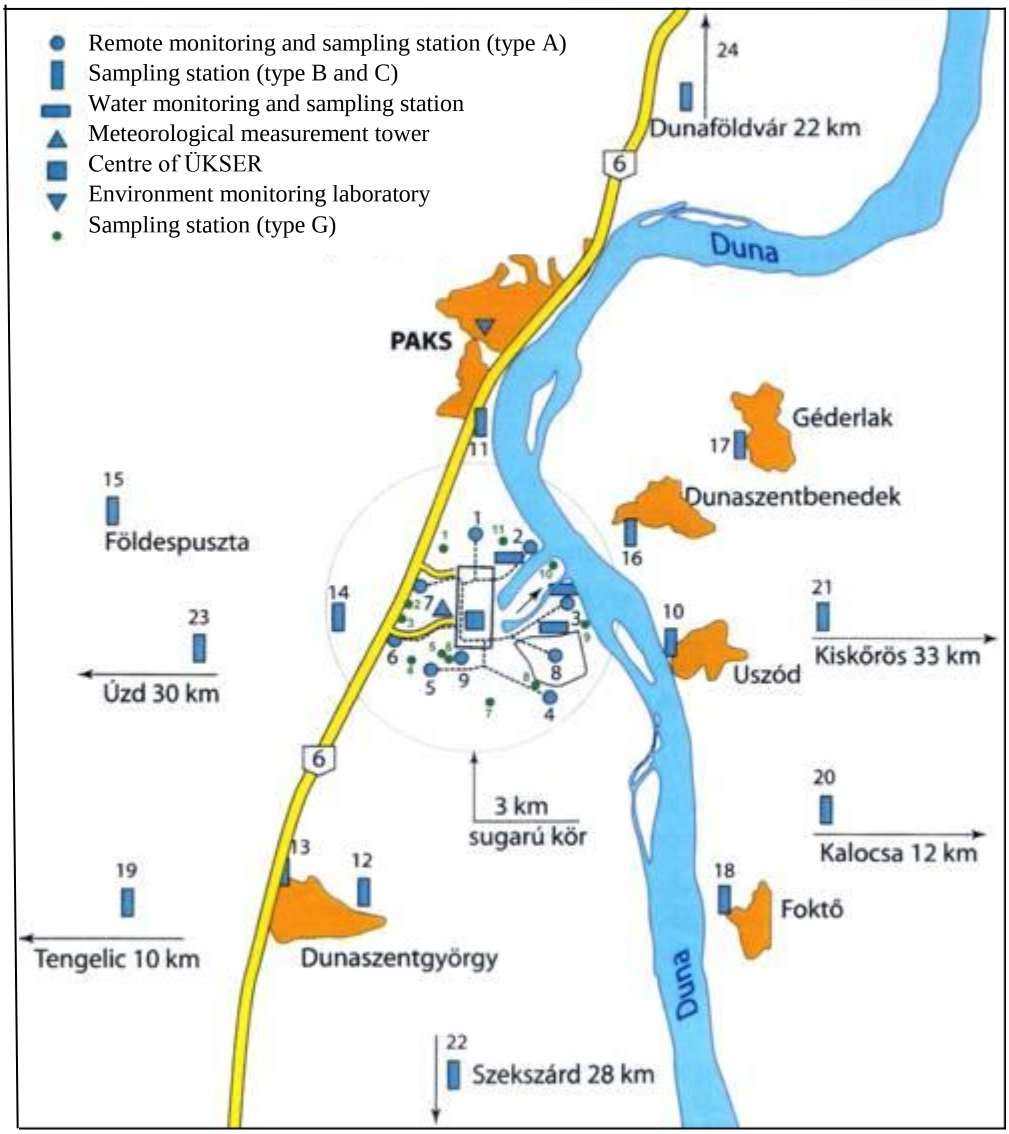
The remote detectors installed along the discharge routes are used for preventing discharge of liquids in an unauthorized way, without laboratory sample analysis.

Environment monitoring

A fixed environmental radiological monitoring system has been installed in the surroundings of the nuclear power plant.

Measuring and sampling capabilities of the various stations:

1. A-type station (9 stations within a range of 1.5km), and B-type (reference) station (1 station, 28 km north of the nuclear power plant):
   - gamma-radiation dosage rate (on-line) and dosage measurements executed by TLD;
   - aerosol and iodine activity-concentration remote metering (on-line);
   - aerosol and iodine sampling;
   - air sampling for determining tritium and radio-carbon;
   - fall-out;
   - soil and grass sampling.
2. C-type station (14 stations within a range of 30 km):
   - dose measurements executed by TLD;
   - if needed, collection of soil, grass, and fall-out samples.
3. G-type station (11 stations within a range of 3 km):
   - gamma-radiation dose rate (on-line).



Note: ÜKSER = Operational Environmental Radiation Monitoring System

Intervention levels

The radiological leader of the Emergency Preparedness Organization, on the basis of values specified below, makes proposals to the leader of the Emergency Preparedness Organization for the introduction of measures to protect the workers, the rescue workers and, in case of quickly escalating events, the population.

On the basis of a decision made by the manager of the Emergency Preparedness Organization, it is possible to order the application of a given protective measure also at values lower than those specified in the following:

Sheltering:	10 mSv avertable effective dose integrated up to two days;
Evacuation:	50 mSv avertable effective dose integrated up to one week for temporary relocation;
Iodine prophylaxis:	100 mGy avertable dose absorbed in thyroid from iodine isotopes.

Action levels to be applied in a nuclear accident:

Isolation: 0.2 mSv/h dose rate due to the plume and fall-out;
Evacuation: 1 mSv/h dose rate due to the plume and fall-out;
Iodine prophylaxis: 0.1 mSv/h dose rate due to the plume.

Discharge data for the years between 2008 and 2010

For the simultaneous discharge of several isotopes along various pathways, the calculation of the discharge limit value criterion is carried out as follows:

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

where: El_{ij}: the discharge limit (Bq/year) of radionuclide ”i” in discharge pathway “j”;

R_{ij}: annual discharge (Bq/year) of radionuclide ”i” in discharge pathway “j”.

$\frac{R_{ij}}{El_{ij}}$ usage of limits for discharge pathway “j” and radionuclide “i”.

Table An8.1.2.c-1 Discharge data for Paks Nuclear Power Plant for the period between 2008 and 2010

Isotope groups	Total discharge for 2008 [Bq]	Discharge limit usage*	Total discharge in 2009 [Bq]	Discharge limit usage	Total discharge in 2010 [Bq]	Discharge limit usage*
Airborne discharges						
Corrosion and fission products	*8.35×10^{8}*	*2.58×10^{-4}*	*8.76×10^{8}*	*7.51×10^{-5}*	*1.02×10^{9}*	*1.38×10^{-4}*
Radioactive noble gases	*2.43×10^{13}*	*3.58×10^{-4}*	*3.04×10^{13}*	*4.15×10^{-4}*	*4.00×10^{13}*	*5.07×10^{-4}*
Radioiodine	*4.53×10^{7}*	*1.56×10^{-5}*	*1.34×10^{8}*	*1.00×10^{-4}*	*1.29×10^{8}*	*9.30×10^{-5}*
Tritium	*2.93×10^{12}*	*1.69×10^{-5}*	*3.47×10^{12}*	*2.01×10^{-5}*	*4.73×10^{12}*	*2.73×10^{-5}*
Radiocarbon	*4.27×10^{11}*	*1.64×10^{-4}*	*5.23×10^{11}*	*1.87×10^{-4}*	*5.61×10^{11}*	*1.85×10^{-4}*
Total	-	*8.13×10^{-4}*	-	*7.98×10^{-4}*	-	*9.50×10^{-4}*
Liquid discharges						
Corrosion and fission products	*1.42×10^{9}*	*7.28×10^{-4}*	*1.16×10^{9}*	*5.68×10^{-4}*	*1.77×10^{9}*	*5.93×10^{-4}*
Tritium	*2.65×10^{13}*	*9.14×10^{-4}*	*2.42×10^{13}*	*8.35×10^{-4}*	*2.82×10^{13}*	*9.73×10^{-4}*
Alpha emitters	*2.32×10^{5}*	*3.22×10^{-7}*	*2.26×10^{5}*	*3.13×10^{-7}*	*1.92×10^{5}*	*2.62×10^{-7}*
Total	-	*1.64×10^{-3}*	-	*1.40×10^{-3}*	-	*1.57×10^{-3}*

* The sum of discharge limit usage for the isotopes of the group.

An8.2 Budapest Research Reactor

An8.2.1 Management of the spent fuel assemblies

Regulatory framework

The handling of spent fuel is a part of the operation of the reactor and thus it is regulated by the national Nuclear Safety Codes.

Systems managing spent fuel elements (removal of decay heat, criticality safety, consideration of other dangers)

The criticality of spent fuel of Budapest Research Reactor similarly to that of nuclear power plants cannot cause any problem because, in line with regulatory requirements, the design of spent fuel storage facilities ensures that the infinite multiplication factor of these facilities is less than 0.95.

During internal fuel transport, criticality safety is provided by the limited number of fuel elements to be transported together (the device is designed for a limited number of fuel elements only).

Heat production of the Budapest Research Reactor fuel elements is so low that the remanent heat is removed by wet storage. After three years of cooling the spent fuel can even be stored in dry storage, from this time on there is no technical objection against fuel transport. During the internal transport of spent fuel the decay heat does not cause a problem for the same reason, and because of the short time.

Highly enriched uranium spent fuel elements irradiated until 2005 and located in the spent fuel store of the KFKI Atomic Energy Research Institute were repatriated to the Russian Federation in 2008 (see chapter B.1.2). The repatriation was preceded by a thorough design process. The service hall (providing the location for the technology operations required for the preparation for repatriation), the support systems, radiation monitoring and physical protection equipment were constructed with the permit and under the supervision of the Hungarian Atomic Energy Authority.

An individual emergency response plan was submitted by the KFKI Atomic Energy Research Institute to the authority to carry out the repatriation.

An8.2.2 Discharges

Regulatory framework

For radioactive discharges to air and water during the use of atomic energy, decree [III.12] on radioactive discharges and their control is authoritative and, taking into account the dose constraint, the following regulatory limits can be derived from it:

Discharge limits to the atmosphere

Applying a 50 μSv/year dose constraint (with Γ=5 safety factor) the derived discharge limits are the following:

Radionuclide	Discharge limit [Bq/year]
^{41}Ar	7.1E+15
^{85m}Kr	5.5E+16
^{87}Kr	1.1E+16
^{88}Kr	5.0E+15
^{133}Xe	2.7E+17
^{135}Xe	3.5E+16

Discharge limits to water

Applying a 50 μSv/year dose constraint (with Γ=5 safety factor) the corresponding derived discharge limits by nuclides are the following:

Radionuclide	Discharge limit [Bq/year]
^{51}Cr	5.0E+12
^{125}Sb	3.0E+12
^{137}Cs	2.0E+10
^{54}Mn	1.7E+11
^{60}Co	6.3E+10
^{65}Zn	2.1E+11
^{110m}Ag	5.8E+10

Control of discharge and measuring equipment

Control

Atmospheric discharge path

During the operation of the reactor ^{41}Ar is produced in the ventilating air circulating around the reactor vessel; this ^{41}Ar is continuously discharged to the atmosphere. Iodine isotopes are occasionally discharged during isotope production (in case of damage of the can); if a fuel element becomes in-hermetic krypton and xenon isotopes are discharged to the ventilation air as well. They are discharged to the environment passing through aerosol and iodine filters. The discharge is continuously checked by the built-in detectors of the Radioprotection Measuring and Control System.

If normal operational values are measured, the samples from the reactor stack are examined in the Material Laboratory of the KFKI Atomic Energy Research Institute, every three months. During this examination the radionuclide content and activity of the samples are measured by gamma spectrometry.

If above-normal operational values are measured, samples are immediately taken and the nuclide specific discharge has to be determined.

Water discharge path

Checking of the water discharge paths is periodic, as the discharge itself is periodic. Discharge may originate from two locations:

- from the so called acid neutralizing shaft;
- from the liquid waste storage tanks.

The acid neutralizing shaft collects the water from the chemical laboratory of the reactor building and from the water preparation unit. If radioactive material gets into the acid neutralizing shaft the radioprotection operator in charge observes the increase in level. After taking a sample, the radionuclide concentration must be determined. When the shaft is filled with water, taking a sample is compulsory before the water can be discharged. The sample is measured in the laboratory of the Radioprotection Group, and knowing the measured result, discharge through the normal sewage system can be permitted only if the activity is below the limit.

The Budapest Research Reactor has two vessels, each of 150 m^3, to collect the liquid radioactive waste. According to the regulations 150 m^3 of free capacity must be maintained in the vessels. Before discharge the nuclide content and concentration of the liquid radioactive waste are measured; then, after cleaning by ion exchangers, the discharge into the sewage system takes place. During discharge the Environmental Control Group has to check daily the water from the ion exchangers and it is then in a position to give permission for the discharge. The water measuring station of the Environmental Control Group is located in the normal sewage system and it continuously measures the gross β and γ activity, as well as the water circulation. Should there be an increase in level, automatic sampling is performed.

Measuring equipment

Atmospheric discharge

The checking of atmospheric discharge is partly performed by the installed detectors of the Radioprotection Measuring and Control System that operate continuously and partly by periodic sampling.

The ventilation system of the Budapest Research Reactor is connected via aerosol and iodine filters to the 80 m stack. The stack is also used by the Isotope Institute Ltd., therefore “reactor”, “isotope” and “common” sections are distinguished. The installed detectors measure the gas activity in various parts of the ventilation system.

There is no radioactive iodine discharge from the Budapest Research Reactor during normal operation. Iodine filters are installed in the ventilation system and there are three iodine detectors located in all three sections of the stack to monitor iodine discharge. The signals of the iodine detectors are connected to the data collecting system of the Environmental Control Group. If the iodine level increases the system gives an alarm and the members of the group examine what environmental effects might be caused by the discharge.

The Material Laboratory measures the samples taken from the ventilation system by means of gamma spectrometry.

Water discharge

Checking of the discharged water is carried out in the laboratory of the Budapest Research Reactor. The gamma spectrum of the water samples is measured to determine the isotope composition and the activity concentration. After evaporation of a 5 ml sample the gross beta activity is determined. The detectors located in the acid neutralizing shaft measure the beta activity of the water.

Results of the measurements

The measured values of the discharges of the Budapest Research Reactor were very low also between 2008 and 2010. For example, the following results were obtained in the period:

	2008	***2009***	***2010***
atmospheric discharge:			
noble gas (only ^{41}Ar)	*42.2 TBq*	*24.6 TBq*	*38.6 TBq*
iodine	*under detection limit (<5 Bq/m^3)*	*under detection limit (<5 Bq/m^3)*	*under detection limit (<5 Bq/m^3)*
aerosol	*under detection limit (<3.7 Bq/m^3)*	*under detection limit (<3.7 Bq/m^3)*	*under detection limit (<3.7 Bq/m^3)*
liquid waste discharge:			
^{60}Co	*no*	*10.3 MBq*	*1.7 MBq*
^{137}Cs	*no*	*20.9 MBq*	*1.25 MBq*

An8.3 Training Reactor

An8.3.1 Management of the spent fuel assemblies

Until now, no spent fuel was generated in the Training Reactor. When removing the fuel at present in the reactor, the management of the spent fuel will take place in line with the Volume 5 of the Nuclear Safety Codes, relating to research reactors.

An8.3.2 Discharges

As a result of the decision of the Office of the National Chief Medical Officer, issued on 4 January 2005, 50 μSv/year dose constraint was prescribed for the Training Reactor. Taking this into account, and considering the relevant decree [III.12], the regulations for the discharge control and environment monitoring of the Training Reactor were prepared. The derived discharge limits and the planned maximum yearly discharges are the following:

Type of discharge	Radionuclide	Discharge limit* [Bq/year]	Planned yearly discharge [Bq/year]
Airborne	^{41}Ar	7.5×10^{11}	$< 6 \times 10^{10}$
Liquid	^{137}Cs	2.0×10^{10}	$< 2 \times 10^{6}$
	^{60}Co	6.3×10^{10}	$< 1 \times 10^{6}$

The actual airborne discharges are less than 10% of the discharge limit; the actual liquid discharges are less than 1% of the discharge limit.