REPUBLIC OF HUNGARY

NATIONAL REPORT

Second Report prepared
in the framework of the Joint Convention on
the Safety of Spent Fuel Management and
on the Safety of Radioactive Waste Management

Second Report, 2005

SECTION A. INTRODUCTION

The Republic of Hungary was among the first to sign the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (hereafter Convention), established under the auspices of the International Atomic Energy Agency, on 29 September 1997, and ratified it on 2 June 1998. The Convention was promulgated in Act LXXVI of 2001. 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).

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 new, potential site was identified in granite host rock for a below-surface repository that could accommodate the LLW/ILW waste of Paks Nuclear Power Plant. Ongoing investigations at this site are being carried out; a four-year research programme is in progress.

It is declared in *Section C (Scope of application)* 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 legal background. The basic regulation in force at present, Act CXVI of 1996 on Atomic Energy, expresses the national policy in the application of atomic energy. It regulates the various aspects of radioactive waste management. Among other items, the 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 installations.

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/HLW and ILW/LLW management, respectively. The Act on Atomic Energy 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 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, disused sources are handled together with other radioactive waste, 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.

Where appropriate, sections or chapters close with statements of fulfilment of obligations under the relevant articles of the Convention.

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 since 31 December 2002. *Annex 7* deals with the remediation of the area of the closed uranium mine. *Annex 8* deals with the spent fuel management and releases of nuclear facilities other than spent fuel management facilities.

The second National Report prepared in the framework of the Convention is a stand-alone document, demonstrating the fulfilment of our obligations undertaken under the Convention. It is based on the revised version of the first National Report, omitting some less important parts concerned with past problems and presenting the new developments. Taking into account the lessons learnt in the first review conference, the Report discusses in a more detailed way the fulfilment of general safety requirements, the releases from nuclear facilities and the safety of spent fuel management in nuclear facilities.

***

This report describes conditions and data as of 15 June 2005.

Declaration

The Republic of Hungary declares that

- *priority is given to the safety of spent fuel management and to the safety of radioactive waste management and both are achieved through legal regulation as well as 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 to mitigate the consequences of such accidents should they occur during any stage of spent fuel management or radioactive waste management.*

Budapest, September 2005

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

SECTION B. POLICIES AND PRACTICES

Generation of radioactive waste started simultaneously with the introduction of the use of isotope technology in Hungary in the early 1960's. The commissioning of the four units of Paks Nuclear Power Plant (1982-1987) increased the generation of both LLW/ILW and HLW.

The basic regulation in force at present, viz. Act CXVI of 1996 on Atomic Energy, expresses Hungary's national policy in the application of atomic energy. Among other aspects, it regulates the management of radioactive waste and authorises the Government and the competent Ministers to issue executive orders specifying the most important requirements in this field. The Hungarian Parliament approved the present Act on Atomic Energy in December 1996; the Act entered into force on 1 June 1997. For radioactive waste repositories the Act prescribes that Parliament's preliminary approval in principle is required to initiate activities for preparing for their establishment.

In accordance with the basic rules laid down in the Act, radioactive waste management shall not impose any undue burden on future generations. To satisfy this requirement, the long-term costs of waste disposal and of decommissioning of the nuclear power plant shall be paid by the generations that enjoy the benefits of nuclear energy production and applications of isotopes. Accordingly, by the Act and its executive orders, a Central Nuclear Financial Fund was established on 1 January 1998 to finance radioactive waste disposal, interim storage and disposal of spent fuel, as well as the decommissioning of nuclear facilities. The Government authorised the Director General of the Hungarian Atomic Energy Authority to establish the Public Agency for Radioactive Waste Management; this agency has been in operation since 2 June 1998.

On the basis of the Act, the Public Agency for Radioactive Waste Management shall design and carry out radioactive waste management in such a way that

- it shall be safe during the whole duration of the activity;
- it shall not affect to a greater extent human health and the environment abroad than that accepted within the country.

The Minister supervising the Hungarian Atomic Energy Authority has jurisdiction over the Fund, the Hungarian Atomic Energy Authority itself is responsible for its administration. Until 1 August 2003,the Hungarian Atomic Energy Authority was supervised on behalf of the Government by the Minister of Economy and Transport; then up to 10 November 2004, by the Minister of the Interior; currently, the Minister of Justice is discharging this responsibility.

The Act on Atomic Energy CXVI of 1996 pays particular attention to providing information to the public. For example, it provides the possibility for the licensee of a radioactive waste repository to promote the establishment of a public control and information association and to grant assistance to its activities in order to give regular information to the population of the communities in the vicinity of the facility. Such associations have been established, and have been operating successfully both around the existing and planned radioactive waste repositories and around the spent fuel storage.

***

The following chapters describe the relevant Hungarian practices and policies. Classification of radioactive waste is given in *Section D*. To enhance the understanding, a map showing the locations of the former, present and planned facilities is given in Figure B-1.

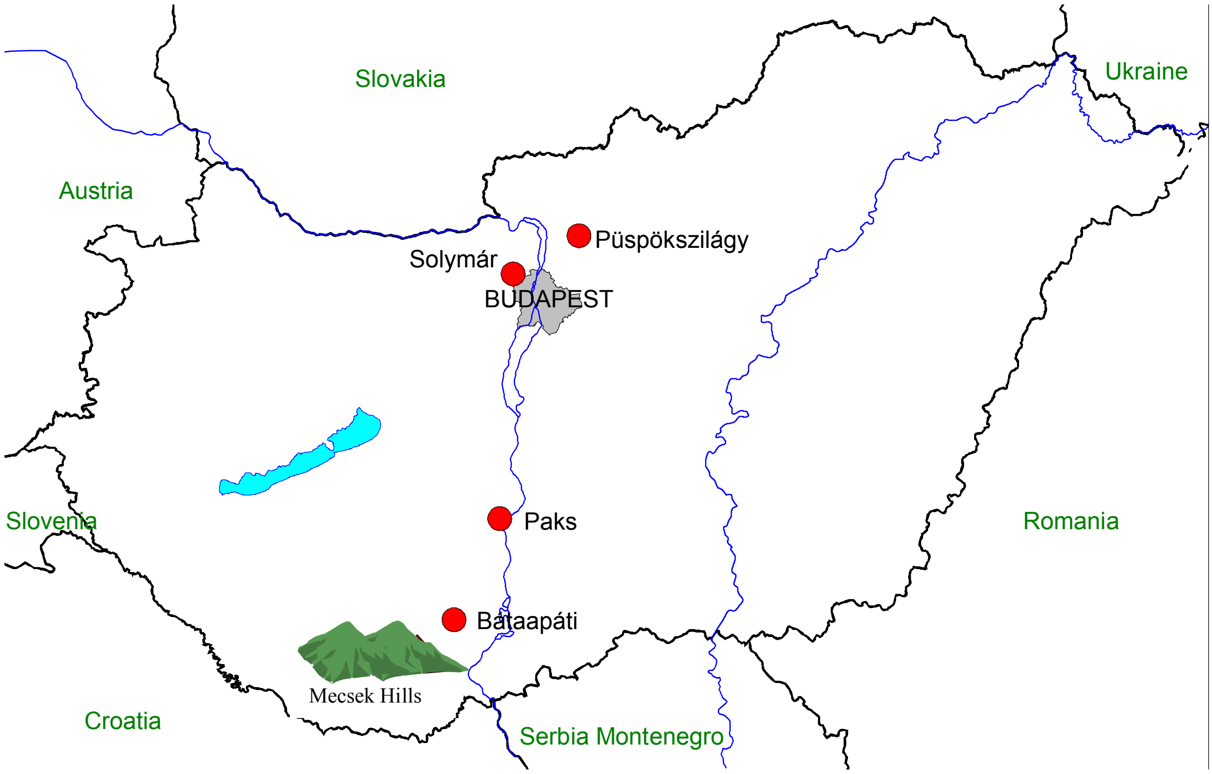

Figure B-1 Sites of importance in Hungary

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, and the training reactor of Budapest University of Technology and Economics.

HLW is generated during the operation of Paks Nuclear Power Plant and is temporarily stored in purpose-designed tube 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 new 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 utilised 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 entitled "Determination and evaluation of handling strategies for spent fuel and HLW, establishing a working programme and time schedule" was elaborated. Its implementation, i.e. the forming of the strategy, is one of the tasks to be faced in the coming years.

Throughout 2004, in parallel with the development of the strategy, the site investigations - using the most up-to-date methods of exploration with quantification of uncertainties and risks - continued. The primary objective of the restarted investigations has been to designate the site of an underground research laboratory (URL). Based on the research plans it is scheduled for 2008. The URL is projected to be finalized in 2012, and the repository is due to be operational by the end of the 2040's.

For the execution of the programme the organizational and the controlling systems as well as the quality management system have been appropriately adapted to the tasks. In 2004, a preliminary safety assessment was prepared that confirmed the suitability of the rock. In mid-2004 an intensive fieldwork was started. Among others, the drilling of the first deep borehole – 1500 m – is in progress.

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 was not required 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. The 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. The first eleven modules (each for 450 assemblies) are ready. 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, 1 km west of the Danube and 1.5 km east of main road No.6.

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

Spent fuel from the 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 at the KFKI Atomic Energy Research Institute, and that of the training reactor (100 kWth) at Budapest University of Technology and Economics contribute to spent fuel generation.

The spent fuel of the Budapest Research Reactor, in accordance with international practice, 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. It is pointed out that the modified storage conditions do not exclude any possibilities of the spent fuel disposal as discussed below.

In that the training reactor is still operating with its originally loaded fuel elements, the problem of the spent fuel remains to be solved in the future.

B.1.2 Policy

For future disposal of SF/HLW, preparations should be accelerated to construct a repository in a geological formation providing long-term isolation. Such a geological formation might well be the Boda Claystone Formation, mentioned in *Chapter B.1.1*, if further investigations confirm its suitability. The repository may also be used either for direct disposal of spent fuel or for wastes from reprocessing.

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.

It is obvious that in the foreseeable future a strategy for the fuel cycle back-end should be elaborated. In the course of the elaboration of the strategy 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.

Spent fuel from the research reactor and from the training reactor

There are three possible options of the disposal of the research reactor fuel and later the training reactor fuel in Hungary. At present, none of these options is definitely possible consequently all three have to be kept open until a decision is due.

The first option is to return the fuel elements to the country of origin, i.e. to the Russian Federation. Negotiations on this option started in the 1980's, but due to major changes in the position of the partner (e.g. stemming from the transformation of the Soviet Union) these discussions were not successful. Recently the International Atomic Energy Agency made some efforts to support this approach. The option is attractive, especially as it might solve the problem once and for all. However, until the financial and administrative details are clarified, no decision can be made. At present negotiations are under way based on an agreement between the United States of America and the Russian Federation.

The second option is to transport the fuel elements to the Interim Spent Fuel Storage Facility and treat them together with the nuclear power plant fuel stored there. This option is less attractive than the first one because the difference in fuel characteristics would cause legal and technical problems.

The third option is to store the fuel elements on the site of the Budapest Research Reactor for a longer term. This option is the least attractive, especially as it was never foreseen that the site might be used for such purposes, and the licensing of a storage facility at the given location could be problematic. Nevertheless, since the other two options may not be feasible, the operator of the Budapest Research Reactor has to consider this option as well. Preliminary discussions indicate that the fuel could be stored on-site in suitable containers (e.g. CASTOR type) placed into a building of light-weight construction. The costs of this option are the highest of the three.

In the second and third options the spent fuel of the Budapest Research Reactor and the training reactor should be managed together with the spent fuel of the nuclear power plant from the viewpoint of final disposal. This possibility is ensured by the planned HLW repository.

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.

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 the Public Agency for Radioactive Waste Management.

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. In the licensing procedure of the new part of the facility the Hungarian Geological Survey questioned the long-term suitability of the site, with the consequence that only temporary operational licences have been issued for the expanded part.

The provisional licence for operation of the repository expired on 31 December 2004. The licensing authority granted the new licence for operation for ten years, the longest possible period of time, based on the licensing documentation as required by the Decree of the Minister of Health, Social and Family Affairs 47/2003. (VIII. 8.), issued meanwhile, and on the position taken up by the 13 special authorities.

Although from early 1997 onwards there were no more waste shipments from Paks NPP to the Radioactive Waste Treatment and Disposal Facility, by the end of 2004 the free capacity of the repository ran short. After the disposal vaults became full, the storage rooms in the treatment building – that has recently been converted into a centralised interim store for institutional radioactive waste – will be used until freeing space for the disposal of additional waste in vaults. To provide free capacity within some existing vaults, volume reduction technology (e.g. compaction), following the retrieval and selection of waste will be used, thereby ensuring considerable amount of space for the further disposal of additional institutional radioactive waste.

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

New 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. As part of the project the whole country was screened in order to identify geological objects suitable for either a near-surface or geological repository. Screening was followed by preliminary site explorations in promising areas where the public were also supportive.

In 1996, based on the final document resulting from the geological investigations as well as on safety and economic studies, a proposal was made to carry out further explorations in the vicinity of Bátaapáti (Üveghuta), about 45 km south-west of Paks to, for a geological disposal site in granite. Another option - that of building a surface repository at Udvari - has been kept open as a possible alternative if, for any reason, the Bátaapáti (Üveghuta) project fails.

At the end of 1998, in the report finalising the geological investigations carried out in 1997-1998, the Geological Institute of Hungary made a recommendation to start the detailed site characterisation in the Bátaapáti (Üveghuta) research area as the preparatory step for the licensing procedure.

At this point the programme found itself in the focus of professional and political debate. This situation led, in 1999, to the Hungarian Atomic Energy Authority requesting the International Atomic Energy Agency to organise an expert mission (WATRP) to review the activities carried out within the framework of the programme. The finding of the mission was that the process appeared to be reasonable, the site potentially suitable, but further work would be necessary with regard to safety assessments. A further finding was that the geological investigations should be continued in order to support the safety assessments.

Parallel to this, the Hungarian Geological Survey's evaluation of the exploration work led basically to the same conclusions.

Safety assessment relying on the results of explorations verified that a safe repository could be established at the recommended site.

Based on the above, in May 2001 the Minister supervising the Central Nuclear Financial Fund signed a four-year exploration programme. In the framework of this programme the geological investigations from the surface were completed by 2003. The geological authority stated that the site fulfils all the requirements formulated in the relevant decree: thus, 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 are necessary to select the rock volume for the repository and its safety zone. The programming of these investigations was approved by the Minister supervising the Hungarian Atomic Energy Authority in December 2004. Further details of the siting process are given in *Section H*.

B.2.2 Policies

The policy concerning the final disposal of LLW/ILW is to be discussed separately for the Radioactive Waste Treatment and Disposal Facility and for the new repository that is planned to host the wastes originating from the nuclear power plant.

Radioactive Waste Treatment and Disposal Facility

Based on the findings of the safety assessments, a project was launched whose main aim was to enhance safety, and to prepare for corrective actions (see *Section H*).

The possibilities of gaining free disposal capacity within the storage vaults should also be investigated. This could provide a long-term solution for disposing of the 10-20 m^3/year radioactive waste from the small-scale isotope users.

Apart from the upgrading of the repository, the long-term, safe, centralised interim storage of those long lived wastes and spent radiation sources as well as wastes containing nuclear material (that are not suitable for near surface disposal) had to be solved by complete reconstruction of the treatment building located on the repository site.

New repository

The disposal of LLW/ILW of the nuclear power plant, including the wastes originating from its decommissioning, will take place in a newly-built repository that should meet all the technical and safety requirements set by the regulators. With this aim in mind, detailed characterisation of the potential Bátaapáti (Üveghuta) site as well as elaboration of the technical design of the repository are in progress.

Underground geological exploration activities of the new waste disposal facility, that started in early 2005 in the granite block qualified as suitable are aimed at defining the location of the repository. In the years to come, two exploration tunnels are due to be driven, each to a length of about 1700 m.

***

The description of the practices and policies followed by the Republic of Hungary in spent fuel management and radioactive waste management fulfils the reporting requirement in Article 32, paragraph 1, of the Convention.

SECTION C. SCOPE OF APPLICATION

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 with Act LXXVI of 2001 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.

***

This declaration is in accordance with Article 3 paragraphs (1) - (3) of the Convention.

SECTION D. INVENTORIES AND LISTS

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 (Budapest University of Technology and Economics) 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%. Based on our present knowledge, the number of spent nuclear fuel assemblies that will have been generated by the end of the life-time of the nuclear power plant (2017) and may remain in Hungary will be about 11 000, with approximately 1286 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 2004, there were 2588 fuel assemblies in the spent fuel ponds in the nuclear power plant, and 3767 fuel assemblies were stored in the Interim Spent Fuel Storage Facility.

In addition, there are 30 damaged fuel assemblies in the refuelling pond at Unit 2. In early 2006, these damaged fuel assemblies will be loaded into cans, then placed in the spent fuel pond and stored there until a decision is reached on their final disposal.

By the end of 2004 the total capacity of the Interim Spent Fuel Storage Facility was 11 modules, enabling the storage of 4950 assemblies. Future expansion of the facility could increase the capacity to 33 modules.

At present, investigations and discussions are in progress on extending the planned 30-year life-time of the nuclear power plant by about 20 years and Paks Nuclear Power Plant has already submitted the corresponding Preliminary Environmental Study to the competent authority. The life-time extension will have an effect on both the amount and the management of radioactive waste and spent fuel. The present Report does not take into consideration the consequences of the life-time extension, as no decision has yet been taken on this issue.

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

The Budapest Research Reactor operates with 230 fuel assemblies of VVR-M2 and VVR-SM types (with an enrichment of 36%). These assemblies are used partly grouped by threes and partly individually. In total, 1381 fuel assemblies are stored on the site with 153.8 kg heavy metal content. The reactor is scheduled to operate until 2023, thus from the end of 2002 to the end of its operational life, a further 1400 VVR-M2 or VVR-SM "single" spent assemblies should be taken into account. If 50% burn up is assumed, this means around 160 kg heavy metal. From previous operations there are also 82 spent fuel assemblies of EK-10 type in the facility with a heavy metal content of 102.2 kg.

There are 24 - partly modified - assemblies of EK-10 type (with an enrichment of 10%) operating in the training reactor of the Budapest University of Technology and Economics, 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*.

D.2.1 Classification of radioactive waste

The 47/2003 (VIII. 8.) Decree of the Minister of Health, Social and Family Affairs was promulgated in 2003, this decree newly regulated – among others – 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 radioisotope involved by it (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 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 radioisotopes

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, while 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 in accordance with the regulations of the European Union by Decree 23/1997. (VII. 18.) issued by the Minister of Health. The procedure of clearance from regulatory control is regulated by Decree 16/2000. (VI. 8.) of the Minister of Health. According to this 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 only in Paks Nuclear Power Plant, in relatively small quantities. It is temporarily stored in the reactor halls in 1114 tube pits designed for this purpose. Up till the end of the year 2004, about 90 m^3 of the storage capacity was filled up out of the total of 220 m^3.

The rate of generation of high level radioactive waste is 3-5 m^3/year; thus the amount that will be generated up to the end of the life-time of the nuclear power plant can be stored in the existing storage.

Taking into account the small amount of high level radioactive wastes generated, the issue of final disposal will have to be solved (also in accordance with the technical design of the plant) only during the decommissioning phase. The available storage capacity can be used until decommissioning, its capacity meets the needs.

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

The small-scale or non fuel-cycle producers - including hospitals, laboratories and industrial companies - generate about 20-30 m^3 LLW/ILW and 1000-3000 spent radiation sources per year. To date, over 4000 consignments of radioactive waste have been delivered to the Radioactive Waste Treatment and Disposal Facility from 430 different consignors. In addition, Hungary is a significant exporter of sealed sources, and recent contracts have included a commitment to accept repatriation of spent sources originating from Hungary.

The amount of LLW/ILW from waste producers outside the fuel cycle disposed of in the Radioactive Waste Treatment and Disposal Facility was 2540 m^3 by the end of 2004.

Between 1983 and 1996 the nuclear power plant shipped 1580 m^3 low level solid waste to the facility, occupying 2500 m^3 of the repository.

By the end of 2004, according to the currently available best estimate, the total activity of the radioactive waste disposed of in the repository was 950 TBq.

Most radioactive wastes, including spent sealed sources, are generated in medical, industrial and research applications. The two most widely used radionuclides with significant inventories are ^{60}Co and ^{192}Ir, used in medical and industrial radiography. 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. During the operation of the nuclear power plant, a certain fraction of the radionuclides that are produced by nuclear reactions in the reactor is taken up in the coolant. Some of these radionuclides, such as tritium and the noble gases, are released to the environment. Aerosols and volatile components, such as iodine, are effectively contained in filters while contaminants in water are contained by ion-exchange resins. Some LLW is produced from routine maintenance (overalls, gloves, etc.). 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.

Gaseous wastes:

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

Liquid radioactive wastes:

- Evaporator bottoms (concentrates)
  Waste waters with chemical content are generated from various sources within the controlled zone of the power plant. These water solutions with low (3-5 g/dm^3) solid content contain all the dissolved chemicals that are used for maintaining the water regime of the primary coolant, reconditioning of the water purifiers, fine adjustment of the reactor power and decontamination purposes. 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 2004 was 4645 m^3, whereof 190 m^3 evaporator bottom was produced in 2004. During the period from the incident of Unit 2 in April 2003 to December 2004, 385 m^3 evaporator bottom containing alpha radiants was produced whose interim storage is maintained in special tanks separately from the other concentrates.

- Evaporator acid solution
  A special tank was designated for storing evaporator acid solution. A quantity of approximately 20 m^3 evaporator acid solution was generated in 2004. Thus, as at 31 December 2004 this tank contained a total of 250 m^3 evaporator acid solution.

- Spent ion exchange resin from the primary circuit
  The ion exchange resins (low, middle and high level) are stored together in two tanks after appropriate treatment. The total quantity of resins used up to 31 December 2004 was 114 m^3; 21m^3 of it was generated in 2004.

  At present, there is no necessity for immediate processing of the ion exchange resins. Bearing mind the plans for modifying the spent ion exchange storage tanks, the available storage capacity - 870 m^3 - is expected to be sufficient for the interim storage of waste volumes to be generated during the life-time of the power plant.

Taking the liquid waste treatment system into consideration, the volume of evaporation wastes and spent ion exchange resins to be stored is expected to be 3700 m^3, and 320 m^3, respectively. This means that 9500 drums of 400 l with cemented concentrate and further 3750 drums of 200 l with cemented ion exchange resin are expected requiring the provision of some 8000 m^3 storage capacity.

Solid radioactive wastes:

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

- Selection and sorting
  The separation of compactable and non-compactable radioactive wastes is ensured basically during the collection by the fact that non-compactable wastes are very rarely loaded into plastic bags. Worn mechanical parts, structural components, insulation materials, and contaminated tools, etc. which - due to their weight and dimensions - cannot

be loaded into plastic bags, are put into drums. The content of bags containing wastes whose surface dose rate is lower than 30 μSv/h can be sorted by a special device to separate items of waste with surface dose rate lower than 1 μSv/h from the radioactive wastes.

- Compaction
  To reduce the volume of compactable radioactive waste, 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.

- Solidification
  Solidification of active sludge removed from the primary waste water collectors, chemical treatment decanters, or interim storage facilities, takes place with the addition of diatomaceous earth in a ratio of 1:1. (The ratio depends on the liquid content of the sludge.) Solid waste, including aerosol filters and solidified sludge, is loaded into special 200 l metal drums (internally coated with plastic). Some half of the waste is plastic, but it also includes textile, heat insulation material, wood, metal, rubber, glass and paper as well.

As at 31 December 2004, 6072 drums containing low and middle level solid wastes were stored in the interim stores. This requires a storage volume of 2125 m^3. Bearing in mind the present rate of waste generation, the annual quantity will be some 950 drums of 200 l, the storage of which requires a gross storage volume of 330 m^3. Taking into account the estimation for the annual quantity of waste (950 drums) for the presently considered design lifetime (up to 2017), the total volume of solid wastes to be disposed of will be some 3500 m^3, that can be accommodated in a storage volume of 6125 m^3.

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. With regard to the waste generated by the dismantling of the reactor, in accordance with the general practice a storage phase is foreseen. This period may last several decades to allow for short lived radionuclides to decay significantly. Even so, much larger volumes of low and intermediate level waste will be produced from the decommissioning than from the operation of the plant. According to calculations, the total decommissioning LLW/ILW as conditioned will amount to some 17 000 m^3. The volume of HLW is estimated to be approximately 410 m^3.

***

With the information given in this Section as well as in Annexes 1-3, the Republic of Hungary fulfils its reporting obligations under Article 32 paragraph 2 of the Convention.

SECTION E. LEGISLATIVE AND REGULATORY SYSTEM

E.1 Legislative and regulatory framework

The Hungarian Parliament approved Act CXVI on Atomic Energy in December 1996, it entered into force on 1 June 1997. The Act considers all legislative, authority-related and operational experience gained during the construction and operation of Paks Nuclear Power Plant. The Act also considers the technological development achieved since the issuance of the previous Act on Atomic Energy of 1980, our international obligations, and, among other requirements, integrates the requirements of the Convention on Nuclear Safety as well. It was also able to take into account the requirements of the Joint Convention on the Safety of Spent fuel Management and on the Safety of Radioactive Waste Management, as in 1996 the drafting of this convention was already in the final stage.

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 Act CXVI of 1996 on Atomic Energy are that it

- declares the priority of safety;
- defines and allocates the tasks of ministries, national authorities and bodies of competence in licensing and supervising procedures;
- 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 Authority to impose fines should rules be infringed;
- 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 installations;
- 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 installations.

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.

There are two more or less specific issues in Hungary defined by Act CXVI of 1996 on Atomic Energy:

- One of them is the definition of nuclear facilities. The definition in the Act is based on that applied in the safeguards agreement between Hungary and the International Atomic Energy Agency. It states that only those facilities are classified as nuclear facilities in which the amount of nuclear material used in the facility is above a certain limit. This means that radioactive waste management facilities (e.g. repositories) are not considered as nuclear facilities.

- The other specific issue is that the Act establishes a so-called 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 management it is an organisation appointed by the Minister of Health, Social and Family Affairs (at present, it is 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 Ministry of 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 Ministry of Environment and Water Management. 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. The tasks related to the radioactivity of the soil and flora belong to the scope of the Ministry of Agriculture and Rural Development.

According to Act CXVI of 1996 on Atomic Energy 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 social-political issues concerning spent fuel and radioactive waste management are given in Act LIII of 1995 on Environmental Protection. The latter Act applies to projects that may have significant adverse 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 regional Inspectorates for Environment, Nature and Water under the Ministry of Environment and Water Management.

Hungary is also committed to certain international agreements concerning environmental impact assessment. As a member of the European Union, Hungary also complies with the relevant Council Directive.

E.1.1 Spent fuel management

Most of the issues related to the nuclear safety of spent fuel management until 5 June 2005 were regulated by Governmental Decree 108/1997. (VI. 25.) The following safety codes were issued as annexes to this decree:

No.1. Authority procedures applied to nuclear power plants;
No.2. The quality assurance code of nuclear power plants;
No.3. General requirements for the design of nuclear power plants;
No.4. Operational safety requirements of nuclear power plants;
No.5. The nuclear safety code of research reactors.

The codes entitled the Director General of the Hungarian Atomic Energy Authority to issue guides concerning the actual implementation of the requirements. By the end of 2002 about 60 guides were in force. These guides - with two exceptions dealt with issues related to the nuclear power plant; two guides covered research reactors.

Earlier, the spent fuel storage facilities were licensed and supervised taking the rules of nuclear power plants as an analogy. On 5 June 2005 Governmental Decree 89/2005. (V.5.) came into force (overruling Governmental Decree 108/1997. (VI. 25.)), and as its sixth appendix a safety code was issued covering all nuclear safety related issues of spent fuel storage facilities. The application of the codes issued as appendices in the new decree will be assisted by guidelines.

E.1.2 Radioactive waste management

The Act on Atomic Energy authorises the Minister of 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 is Ministerial Decree 16/2000. (VI. 8.). The Decree requires that regulatory rules must be applied to all activities involving the use of atomic energy and ionising radiation, i.e. both for spent fuel management and radioactive waste management. The radiation protection requirements of the final disposal of radioactive waste are set down in Decree 47/2003. (VIII.8.) issued by the Minister of Health, Social and Family Affairs. 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.

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 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 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.

- Commissioning license for final disposal are grantable for 10 years, and for interim storage for 5 years, but these licenses could be extended on the basis of a periodic 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, Ministerial Decree 62/1997. (XI. 26.), issued by the Minister of Industry, Trade and Tourism, 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 on 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. Currently the revision of the decree is in progress.

E.2 Regulatory body

E.2.1 The Hungarian Atomic Energy Authority

According to the Act on Atomic Energy, 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 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 Coordination Council).

The Hungarian Atomic Energy Authority is a central public administration organisation, dealing with the peaceful use of nuclear energy under the supervision of the Government. It is independent both organisationally and financially from all organisations interested in promoting the application of atomic energy.

Its scope of competence comprises, among others, nuclear safety licensing (on the levels of the facility, systems and structures/components) and supervision of nuclear facilities in each phase of the lifecycle, in the framework of which any matters concerning building authorisation and supervision of safety related buildings/structures are also covered.

The Hungarian Atomic Energy Authority’s activities related to the safety of nuclear facilities were surveyed by an International Atomic Energy Agency IRRT (International Regulatory Review Team) mission in 2000. On the basis of the recommendations of the mission as well as of the findings of the Authority itself some organisational changes were carried out. In 2002 a quality management system based on international standard ISO 9001:2000 was introduced. After the IAEA mission following the serious incident in the Unit 2 of Paks NPP in April 2003 the structure of the HAEA was modified again. The present structure is illustrated in the organisational chart (Fig. E.2.1-1)

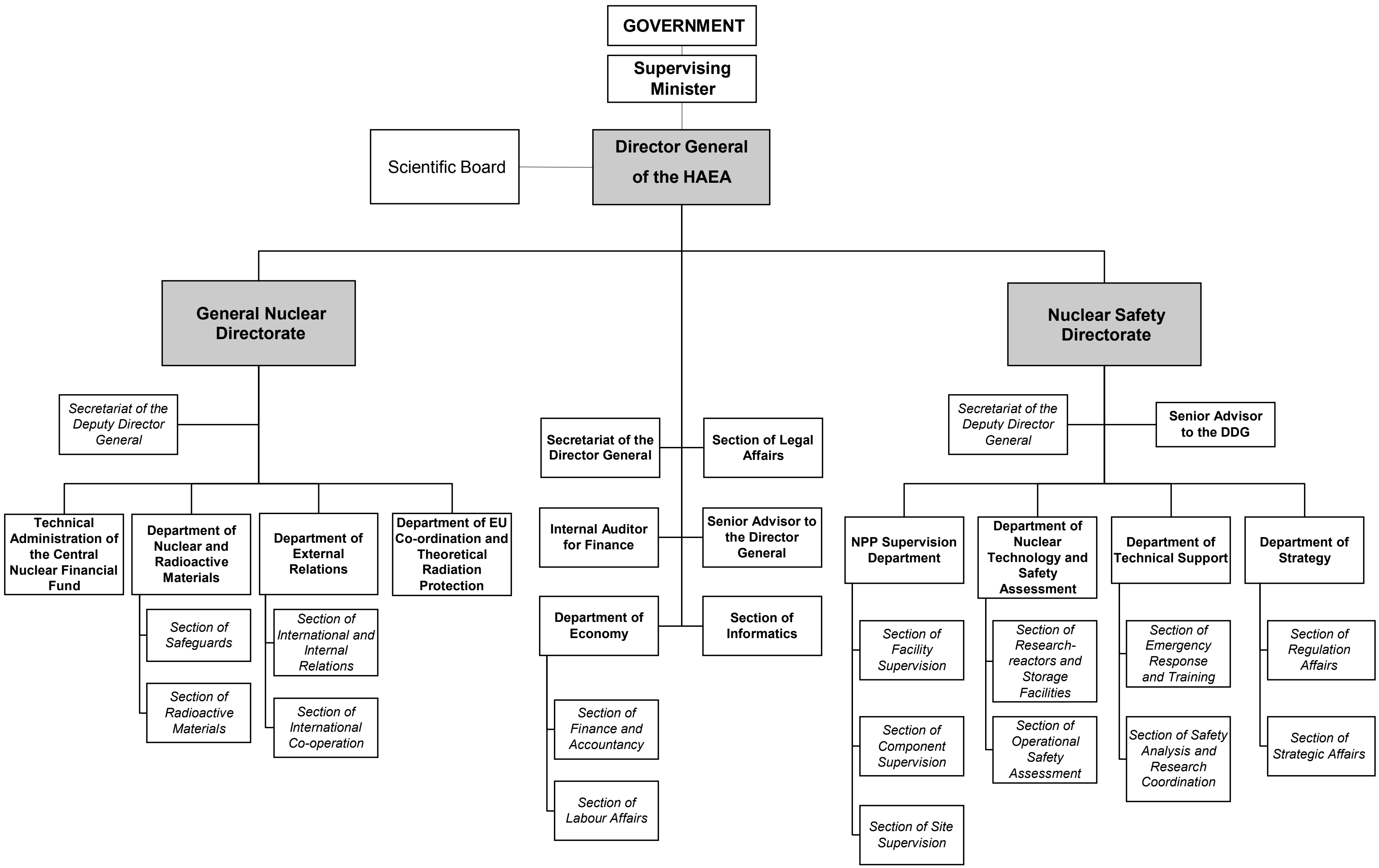

Fig. E.2.1-1 Organisational structure of the Hungarian Atomic Energy Authority

Regulations allow the involvement of professional experts (both institutions and individuals) in all cases when the Authority itself does not possess the expertise required.

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

In accordance with Act CXVI of 1996 on Atomic Energy, the work of the Authority is also supported by a Scientific Council that is composed of members of national reputation. The Council'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 National Public Health and Medical Officer Service

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 various regionally competent bodies (regional radiological centres) of the National Public Health and Medical Officer Service. This applies to spent fuel management facilities as well.

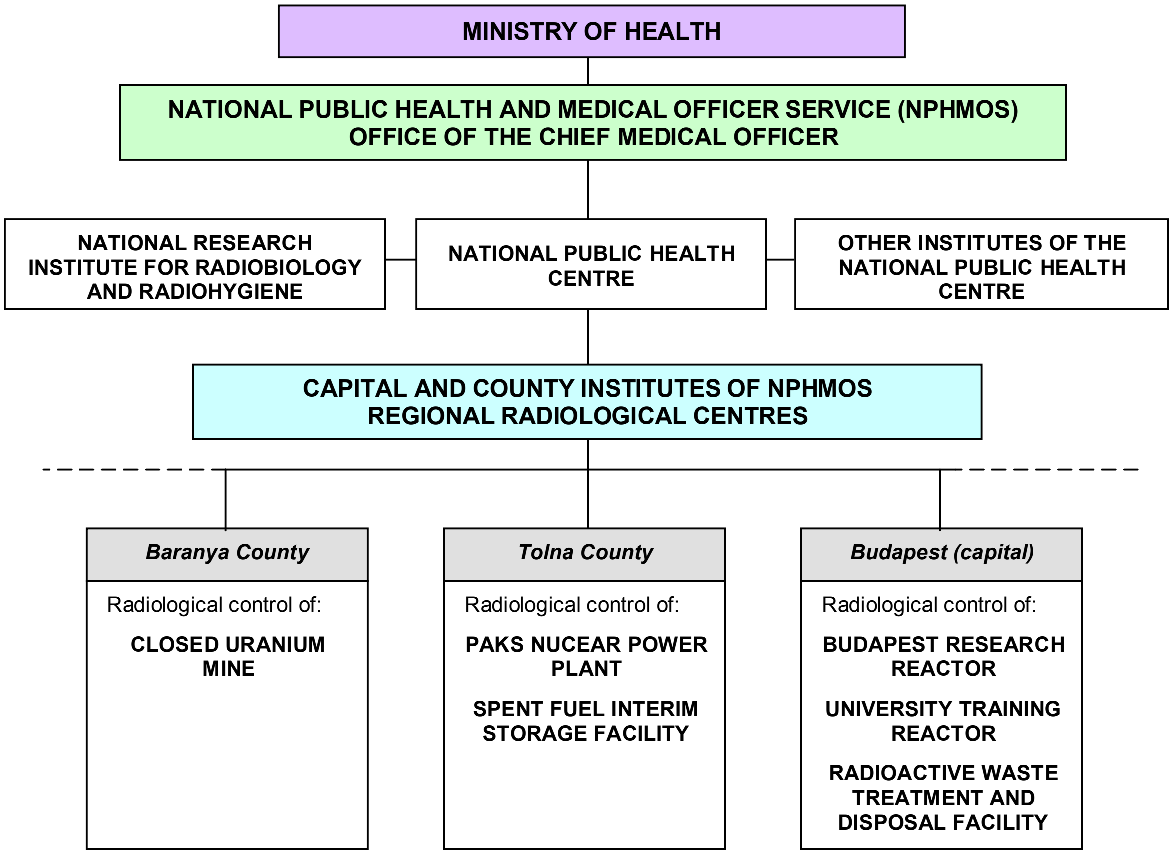

Figure E.2.2-1 Structure of the radiological health authority and the main supervisor authorities in Hungary

The national-level body, the Office of the National Chief Medical Officer, is the licensing authority for radiation protection regulation, the health physics service section of the facilities, and it also participates in the nuclear safety licensing procedures as a special authority on radiation protection questions having the right of consent. 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 Tolna County Institute of the National Public Health and Medical Officer Service (a regional radiological centre) is empowered to supervise (including 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 operating periods (site selection, construction, commissioning, operation, decommissioning) during the lifecycle of a spent fuel storage facility. Moreover, separate licences must be obtained for all changes of construction to a given facility or changes to its components/constructions should they belong to safety classes.

Within the licensing procedures, the specific aspects are dealt with by the special authorities designated by law (see also E.3.2). The Hungarian Atomic Energy Authority has to take into consideration the additional requirements 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 if all requirements are met.

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

E.3.2 Radioactive Waste Management

The Minister of Health, through the National Public Health and Medical Officer Service, with expert advice and technical assistance provided by the National Research Institute for Radiobiology and Radiohygiene performs the licensing and controlling of siting, construction, commissioning, operation, modification and closure of a radioactive waste disposal facility.

In the licensing procedure all the other relevant public administration organisations participate as so-called special authorities. These special authorities designated in Decree

47/2003. (VIII.8.) issued by the Minister of Health, Social and Family Affairs have jurisdiction 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 Hungarian Atomic Energy Authority enforces aspects relating to general nuclear safety, • the Minister of Defence enforces aspects relating to national defence;
- the Animal Health and Food Control Station of the competent county/capital enforces aspects relating to animal hygiene and food protection;
- the Plant Protection and Soil Conservation Service of the competent county/capital enforces aspects relating to plant hygiene and soil protection;
- the competent county / capital Inspectorate of Transport enforces aspects relating to traffic and transport;
- the Hungarian Police Headquarters Department of Administration enforces aspects relating to public security and police administration;
- the competent County Directorate for Emergency Management/Capital Directorate for Civil Defence and Capital Headquarters of the Fire Service enforces aspects relating to civil defence and fire protection.;
- the regional competent Office of the Hungarian Geology Survey enforces aspects relating to geology;
- the Hungarian Mining Office enforces aspects relating to mining technology and mining safety.

E.4 Inspection

Act CXVI of 1996 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 or the evaluation of such inspections may also be performed by external experts or expert bodies upon the written commission of the authority.

In addition to the authority'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.

In the area of spent fuel management the Hungarian Atomic Energy Authority - on the basis of the recommendations of the IRRT mission (in the year 2000) mentioned above - upgraded its supervisory process. Within the framework of this process it introduced an integrated, comprehensive inspection system and extended its activities for retracing events affecting safety, and its analysis of issues relating to safety.

The periodic reassessment of the nuclear safety of nuclear facilities performed every ten years on the basis of a comprehensive, predefined programme (taking into consideration the present international practice) is the Periodic Safety Review process required by the various legal provisions. Decisions on the further validity of the operation license, 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.

In the field of radioactive waste management, the competent institutes (regional radiological centres) of the National Public Health and Medical Officer Service carry out regular inspection and surveillance at licence holders. Furthermore, they check the licensed modifications and the 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 authority (Capital Institute of the National Public Health and Medical Officer Service, a regional radiological centre), with expert advice and technical assistance provided by the National Research Institute for Radiobiology and Radiohygiene) inspects the Radioactive Waste Treatment and Disposal Facility at Püspökszilágy twice a year. During this inspection the authority supervises the site and carries out environmental sampling in the vicinity.

E.5 Enforcement of the regulatory requirements

The conditions for enforcing the legal mandates of the authorities are contained in Act IV of 1957 regarding the general rules of administrative procedure, in Act IV of 1978 (Penal Code), and in Governmental Decree 114/2003 (VII.29.) (on the scope of the Hungarian Atomic Energy Authority).

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 of a radioactive waste disposal facility 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 any of the stipulations of any individual licence issued on the basis of the above. In cases falling under the Penal Code the authority has a reporting obligation.

With regard to spent fuel management, the discharging of legal authority is facilitated by the enforcement policy of the Hungarian Atomic Energy Authority introduced in 2001. The enforcement policy summarises the objectives and necessity along with the legal resources. For consistency and coherency the enforcement activity is performed on the basis of a procedure published in an internal document of the Hungarian Atomic Energy Authority in 2002. This procedure is made available to the licensees, mainly to call their attention to the components of the decision-making process, and also for purposes of transparency.

The main objectives of the enforcement policy are to forestall insofar as it is possible the infringing of existing rules; to facilitate the early, voluntary revealing of deviations from prescriptions; to support the reporting and correction of any deviations even, if necessary, by means of sanctions.

***

On the basis of the above it is stated that in the Republic of Hungary the implementation measures of obligations contained in the Convention for establishing the legislative and regulatory framework, defining applicable safety requirements, allocating the responsibilities of the organisations involved and the operation of designated authorities related to licensing, inspection, assessment and enforcement processes comply with the requirements stipulated in Articles 18, 19 and 20.

SECTION F. OTHER GENERAL SAFETY PROVISIONS

F.1 Responsibility of the licence holder

In general, Act CXVI of 1996 on Atomic Energy 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 Public Agency for Radioactive Waste Management. The basic tasks of the licensee are 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 quality assurance 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 maintain, at the lowest level reasonably achievable (taking into account the social and economic factors), the radiation exposure of the employees and the public;
- 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 radiation protection authority and to submit them for approval to the environmental protection inspectorate prior to the construction of a given facility; in the case of existing facilities this was to be performed in the year 2001;
- to determine the planned release levels for normal operation;
- to ensure compliance with the release 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) Governmental Decree 17/1996. (III. 31.) is in force.

The licensee should, according to Governmental Decree 248/1997. (XII. 20.) 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 emission limits are or may be exceeded and assure the conditions thereof;
- supply data on the quantity and composition of the material emitted 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

F.2.1 Human and financial resources of the authorities

F.2.1.1 The Hungarian Atomic Energy Authority

The authority for spent fuel management, the Hungarian Atomic Energy Authority, employs 89 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.

To acquaint the staff of the Authority with the practice of the power plant, a great deal of their training is at the nuclear power plant itself or another type of training is given which conforms to the training system of the power plant. International courses are also integrated into the training system. Representatives of the Authority take part in the work of many international organisations and committees.

A systematic education plan has been prepared by the Authority for training the 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 installations are obliged to pay a supervision fee to the Authority in the way and to the extent defined in the Act on Atomic Energy, 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 installations, and its funding is sufficient to carry out its duties efficiently.

F.2.1.2 The National Public Health and Medical Officer Service

In Hungary, the licensing of radioactive waste management belongs to the National Public Health and Medical Officer Service.

The National Public Health and Medical Officer Service, as the competent authority, is independent from the sphere of the licensees. In 7 county (including the capital) institutes (regional radiological centres) some 70 well-qualified experts are employed in the field of radiation protection. In special cases, the tasks for the authority undertaken by the regional radiological centres of the National Public Health and Medical Officer Service are supported by the National Research Institute for Radiobiology and Radiohygiene (with about 140 highly qualified employees). The National Radiation Hygiene Preparedness Service with its appropriately equipped motorcar provides a 24-hour service a day.

The National Public Health and Medical Officer Service is a central public administration office financed from the state budget.

F.2.2 Human and financial resources of the licensee

F.2.2.1 Human resources

Act CXVI of 1996 on Atomic Energy 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 (Governmental Decree 240/1997. (XII. 18.)) commissioned the Director General of the Hungarian Atomic Energy Authority with the task of establishing this organisation, viz. the Public Agency for Radioactive Waste Management.

The financial resources for the operation of the Public Agency for Radioactive Waste Management are provided from the Central Nuclear Financial Fund established in accordance with the Act on Atomic Energy. The status and operational conditions of the Public Agency for Radioactive Waste Management as a public utility are defined by Act CXLIV of 1997 on business organisations and Act CLVI of 1997 on non-profit organisations.

Four directorates have been set up within the Public Agency for Radioactive Waste Management under the control of the director of this organization. These directorates are responsible for the following activities:

- elaboration of the medium- and long-term plans (strategies) of the agency;
- cost estimates to identify the necessary payments into the Fund each year;
- preparation of technical and financial reports for the activities financed from the Fund;
- preparation for, and implementation of the construction of storage / disposal facilities for the final disposal of radioactive wastes;
- 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 installations;
- operation of the existing low- and intermediate level waste repository, i.e. the Radioactive Waste Treatment and Disposal Facility;
- public relations and information.

The organizational scheme of the Public Agency for Radioactive Waste Management is shown in Figure F.2.2.1-1.

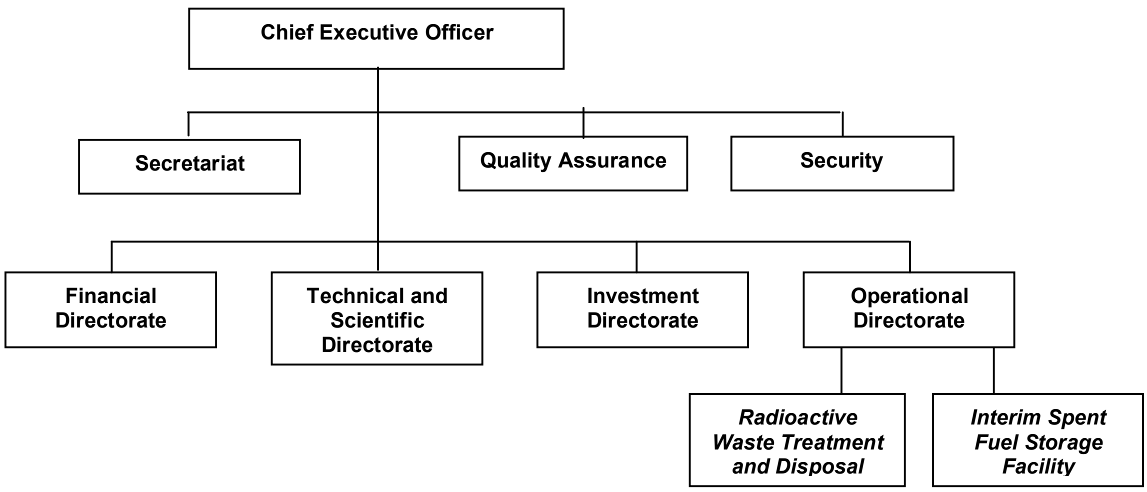

Figure F.2.2.1-1
Organizational scheme of the Public Agency for Radioactive Waste Management

The central offices of the agency are in Budaörs, close to Budapest. The management and administrative activities within each directorate are performed at Paks, on the site of the Interim Spent Fuel Store Facility. The Radioactive Waste Treatment and Disposal Facility is situated in Püspökszilágy. Altogether 112 people work at these three sites. This number of staff does not include those responsible for the Interim Spent Fuel Storage Facility's operation and maintenance, which functions are performed on a contractual basis by the personnel of Paks Nuclear Power Plant.

In accordance with the legal regulations, the professional and health physics qualification requirements of the employees of the Public Agency for Radioactive Waste Management are the same as for the employees of Paks Nuclear Power Plant.

F.2.2.2 Financial resources

The Minister supervising the Hungarian Atomic Energy Authority disposes of the Central Nuclear Financial Fund (hereinafter Fund), while the Hungarian Atomic Energy Authority is responsible for its management. The Fund is a separate state fund pursuant to Act XXXVIII of 1992 on Public Finance, exclusively 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 the Public Agency for Radioactive Waste Management. 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. Payments are based upon submittals prepared by the Public Agency for Radioactive Waste Management and approved by the Hungarian Atomic Energy Authority and by the Hungarian Energy Office. Payments by Paks Nuclear Power Plant are taken into account when the price of electric energy is being determined.

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.

For nuclear installations financed from the central budget (research reactor and training reactor), the sources required to cover the payment 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 repository.

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. This practice was interrupted for 2001-2002, but it is now restored again as of 2003.

The following table presents the development of the financial status of the Fund from 1998 to 2004.

Table F.2.2.2-1 Yearly income and expenditure of the Fund
(in M HUF - million Hungarian Forints [1])

	1998	1999	2000	2001	2002	2003	2004
Payment by Paks NPP	7428.7	9164.9	9311.3	14877.1	17199.3	21081.5	23930.6
Payment by other organisations	3.6	6.2	5.6	9.8	6.5	8.8	10.4
Contribution from the central budget (maintaining value)	-	227.9	1132.1	0	0	2612.9	3585.1
Expenditure from the Fund	3941.1	3630.9	2094.1	6084.0	11239.4	9183.5	9705.9
Accumulation in the Fund	3832.7[2]	5768.1	8354.9	8802.9	5966.4	14519.7	17871.1

Notes: [1] exchange rate in May 2005: 1 Euro ~ 253 HUF
[2] because of a tax refund there was additional income in this year

By the end of the year 2004, the total sum accumulated in the Fund was 65 115.7 million HUF.

F.3 Quality Assurance

All facilities dealing with spent fuel management, in line with all other nuclear facilities, are obliged by the Act on Atomic Energy and Governmental Decree 89/2005. (V. 5.) to operate under an appropriate quality assurance 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. The legally binding safety codes also contain prescriptions on the functioning of the licensee's safety system based on the Quality Assurance Safety Code of the International Atomic Energy Agency. All organisations contracted by the licensee and working on safety-classified systems/structures/components are obliged to maintain a quality assurance system. The licensee has the responsibility of qualifying contractors as suitable for the assigned task. The Hungarian Atomic Energy Authority is empowered by law to inspect the effectiveness of any given quality assurance system. The aspect of quality management is taken into account in the licensing process as well as in the supervision of adherence to prescriptions. The Public Agency for Radioactive Waste Management introduced a quality management system that was officially certified in accordance with ISO 9001:2000.

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.

The Public Agency for Radioactive Waste Management introduced its environment management system according to the standard ISO 14001:1996 too, that was certified on 6 January 2004.

The tasks for the authority, including measurements, of the National Public Health and Medical Officer Service are also carried out under a quality assurance programme. Most of the laboratories are accredited, the accreditation of the remaining laboratories is under way.

F.4 Operational radiation protection

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 CXVI of 1996 on Atomic Energy, Decree 15/2001. (VI. 6.) issued by the Minister of Environment regulated 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 Chief Medical Officer's Office. For example, the dose constraintfor Paks Nuclear Power Plant is 90 μSv/year, for the Interim Spent Fuel Storage Facility 10 μSv/year, for the Radioactive Waste Treatment and Storage Facility 100 μSv/year, for the Budapest Research Reactor 50 μSv/year, for the Training Reactor of Budapest University of Technology and Economics 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 Inspectorate to carry out sampling and on-site measurements for monitoring radioactive releases and supply the Inspectorate 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

F.5.1 Organisation

The National System for Nuclear Emergency Preparedness was created at the end of 1989. As a consequence of Act CXVI of 1996 on Atomic Energy, Governmental Decree 248/1997. (XII. 20.) reformulated the national nuclear emergency preparedness system. In 1999 a comprehensive act was promulgated dealing with the prevention and mitigation of all kinds of catastrophic events, nuclear emergencies included.

The protection system against catastrophes in emergencies is managed by the Governmental Co-ordination Committee. The composition of the Committee depends on the type of emergency and is as follows:

- president: the Minister of Interior;
- vice president in case of nuclear emergency: the Director General of the Hungarian Atomic Energy Authority;
- members: the administrative state secretaries of the ministries involved in the given emergency and a delegate appointed by the Minister of the Prime Minister's Office.

The bodies of the Governmental Co-ordination Committee are the Secretariat, the Operational Staff, the National Defence Committees (one for each type of emergency), and the Scientific Council. The administrative tasks of the Governmental Co-ordination Committee are managed by the Secretariat functioning on the basis of the Ministry of Interior whose tasks also include co-ordination of the activities of the given National Defence Committee, the Operational Staff, and the Scientific Council.

Within spent fuel management and radioactive waste management facilities, the person responsible for carrying out tasks related to the prevention of accidents and the mitigation of consequences, should they occur, is the executive manager of the facility.

In the case of nuclear or radiological emergencies it is the task of the Hungarian Atomic Energy Authority to evaluate the nuclear and radiation situation and forecast its propagation.

The information in support of decision-making is provided by the following organisations:

- the Centre for Emergency Response, Training and Analysis of the Hungarian Atomic Energy Authority;
- the International Contact Point at the Hungarian Atomic Energy Authority;
- the Nuclear Emergency Information Centre operated by the Directorate General for National Emergency Management of the Ministry of Interior;
- the Information Centre of the National Environmental Radiation Monitoring System working on the basis of the Ministry of Health.

F.5.2 The National Emergency Response Plan

The current National Emergency Response Plan entered into force in 1994 and was prepared in line with the structure and responsibilities valid at that time. Since that time, a comprehensive revision of the National Emergency Response Plan has been completed. As a result of the revision, the new plan reflects the recent changes in the Hungarian emergency preparedness system. Its structure and content follows the recommendations of the International Atomic Energy Agency.

The revision introduced classification of facilities according to 5 planning categories and established (maximum) 3 prevention zones around each. Paks Nuclear Power Plant (and 3 foreign nuclear power plants relatively close to the Hungarian border) is within category I. The Interim Spent Fuel Storage Facility at Paks, the Budapest Research Reactor and certain isotope production facilities fall into category II. The training reactor of the Budapest University of Technology and Economics and the Radioactive Waste Treatment and Disposal Facility in Püspökszilágy fall into category III.

In accordance with the National Emergency Response Plan, in the case of a nuclear emergency the public is warned by a system of sirens. Covering a 30 km radius of the nuclear power plant (and thus of the interim storage of spent fuel) this system was modernised and can also transmit spoken announcements. Generally, the information is distributed via public media, special arrangements are set out for this purpose.

F.5.3 The Nuclear Emergency Management System of the Facilities

F.5.3.1 The Interim Spent Fuel Storage Facility

Paks Nuclear Power Plant and the Interim Spent Fuel Storage Facility have an integrated emergency prevention system and organisation, as their sites are neighbouring. The emergency situations included in the planning cover all types of nuclear emergencies in the nuclear power plant as well in the storage facility. As the storage facility is based completely on passive air-cooling, the possible accidents are much less dangerous than those of the nuclear power plant. Therefore 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 accident prevention activities are controlled by the Emergency Response Plan valid for the given facility.

The Emergency Response Plan for the Interim Spent Fuel Storage Facility includes actions and measures to be taken to assess, mitigate and remove the consequences of nuclear hazard conditions and disasters of natural or industrial origin that have already occurred. Off-normal events of both external and internal origin are taken into account in the Plan. With the use of accident analyses and based on the technological status of the facility as well as the evolved radiological conditions, this document provides a classification of the hazard conditions and specifies the organisational and technical measures required for controlling the emergency situation.

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

The accident prevention and emergency response activities are performed in accordance with the relevant operation and maintenance, and accident prevention procedures.

The work of the emergency response organisation of the Public Agency for Radioactive Waste Management is limited to the site area. The organisation has no authority to take action outside the site (e.g. in neighbouring settlements).

The Emergency Response Plan of the Interim Spent Fuel Storage Facility also includes the arrangements that are in place to ensure co-operation with other bodies and organisations to allow them to perform their emergency response work. The provisions and arrangements specified by the Plan can also be used for the control and prevention of disasters of non-nuclear origin.

F.5.3.2 The Radioactive Waste Treatment and Disposal Facility

The Emergency Response Plan of the Radioactive Waste Treatment and Disposal Facility includes the description of events potentially occurring in the facility, the hazard categories to be adopted, the actions to be carried out by the site staff, the list of people to be notified and the order of their notification. In order to be able to perform the emergency response activities, an appropriate Emergency Response Organisation has been set up within the operational personnel of the repository.

F.5.4 Emergency Exercises

On-site and off-site exercises, including national and international exercises, are organised regularly according to yearly plans.

One managerial and one general exercise as well as four partial exercises are organised yearly in the Interim Spent Fuel Storage Facility. The competent specialists of the Hungarian Atomic Energy Authority act as observers.

A complex national level exercise involving all organisations was carried out in the year 2004. The Director General of the Directorate General for National Emergency Management was the main controller of the exercise. The Director General the Hungarian Atomic Energy Authority was responsible for the evaluation of the exercise. . Based on the collected experiences and suggestions, improvements to the National System for Nuclear Emergency Preparedness will be carried out in 2005.

F.5.5 International co-operation

It is a fundamental task of the Hungarian Atomic Energy Authority to ensure the participation of the Republic of Hungary in the international system of co-operation related to the prevention and handling of nuclear accidents. This system of co-operation is based on the conventions concluded within the framework of the International Atomic Energy Agency. 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 utilise INES, introduced by the International Atomic Energy Agency.

Well before Hungary joined the European Union, it had become a member of the ECURIE, the early notification system operated by the EU.

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.6 Decommissioning

Decommissioning is not a current issue for the Hungarian nuclear facilities. Nevertheless this question has been covered in regulations, as the final phase of the life-cycle of the installations. As for all other phases, it requires a nuclear safety licence. For decommissioning, a multi-step licensing procedure is established, where the first step is to obtain the authorities' consent to terminate operation. A further requirement is a valid environmental protection licence based on environmental impact assessment and public hearing. As in all phases of the life-cycle of a facility, radiation protection authorities are involved 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 nuclear power plant, the 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 a 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 for granting the operating licence. All decommissioning plans have to cover organisational and qualification questions together with the technical issues.

In the case of Paks NPP no such preliminary decommissioning plan was originally made. This situation was corrected in the early 1990s and since that time it has been updated regularly.

The Periodic Safety Review (2003) of the Budapest Research Reactor prescribed that a Preliminary Decommissioning Plan be prepared for the facility with the deadline of 2005. In the case of the Training Reactor this problem will be solved during the next Periodic Safety Review (2007). The IAEA effectively assists/supports these activities in the form of expert missions.

The Interim Spent Fuel Storage Facility was already designed by taking into account all relevant requirements of decommissioning and it has an adequate preliminary decommissioning plan.

***

As demonstrated in this Section, the measures taken in Hungary to implement the requirements regarding general safety provisions fulfil the obligations set out in Articles 21-26 of the Convention.

SECTION G. SAFETY OF SPENT FUEL MANAGEMENT

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

G.1 The Interim Spent Fuel Storage Facility

Siting

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 occurred in 100 years. The structure of the basement hinders 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 for design earthquake;
- 0.35 g for 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 recurrence frequency of one in 10 000 years; this value was accepted by the licensing authority.

In the absence of site-specific response spectra values, data from the US NRC Reg. Guide 1.60 were used for the assessments. 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

At present, the approved extent of construction of the Interim Spent Fuel Storage Facility covered by the Final Safety Assessment Report provides storage for 4950 spent fuel assemblies. This capacity was specified taking into account the requirements for storing the quantity of spent fuels unloaded from the power plant during a ten-year operation period. The design allows for the extension of the store facility up to 33 modules (14 850 storage places).

The major design parameters with respect to the safety of the storage facility are as follows:

1. *Handling and storage.* Fuel assemblies are kept vertically.
2. *Loading.* Spent fuel assemblies are loaded individually in separate storage tubes.
3. *Monitoring*. The ambient medium of the spent fuel assemblies is maintained by a gas supply system, supplying nitrogen into the storage tubes.
4. *Passive cooling*. 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 storage gas within the storage tube.

5. *Shielding*. The spent fuel assemblies are handled/located in an area surrounded by massive boundary components:the fuel handling machine during loading and the concrete walls of the building structure during the storage period. This enables the radiological effects to be kept low in accordance with the ALARA principles.
6. *Isolation*. The isolation of the spent fuel assemblies (from the environment) is provided by the fuel storage tubes and the gas supply system during storage, and by the transport cask, the fuel drying tube, and the fuel handling machine during handling operations.
7. *Criticality*. The development of criticality is prevented by
   - the individual handling and loading of the assemblies from the transport cask into the modules, and
   - the geometrical arrangement of the fuel storage tubes and the dry storage method within the storage tubes.
8. *Transport into the Interim Spent Fuel Storage Facility*. The existing fuel handling procedures of Paks Nuclear Power Plant are to be applied for the transport of the spent fuel assemblies. These procedures are in agreement with the regulatory approved cask handling procedures.
9. *Transport within the storage facility*. A fuel handling machine is used for loading the assemblies from the transport cask into the storage tubes during loading operations and, in the reverse procedure, from the fuel storage tubes into the transport cask during unloading operations. Transport of the fuel assemblies between the various stations takes place within the naturally-cooled space of the fuel-handling machine.
10. *Contamination isolation.* Ventilation systems ensure the isolation of contamination, potentially caused by airborne radioactive materials. In this way any occupational radiation exposures can be kept low to fulfil the requirements derived from the ALARA principles.
11. *Fire protection*. The design and the steel- and reinforced concrete structure of the Interim Spent Fuel Storage Facility ensure that the occurrence and propagation of significant fires is not possible.
12. *Decommissioning*. The construction of the storage facility is designed to prevent the spreading of contamination, and to allow the removal of any contamination during operation or decommissioning.
13. *Wastes*. The design of the storage facility ensures that the amount of solid, gaseous, and liquid wastes is minimised.
14. *Control and monitoring*. Normal operational control and monitoring activities are performed in the storage facility. In addition, safeguard and security monitoring services are also provided.

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

- minimum 3-year cooling time after discharge from the reactor
- the highest initial enrichment: 3.6%
- average burnup: 42 GWday/tU
- highest burnup: 50 GWday/tU
- 478 W/assembly remanent heat power for average burnup
- 717 W/assembly remanent heat power for highest burnup
- hermetic (intact) assemblies

Safety Assessment

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.

Although the Interim Spent Fuel Storage Facility was designed expressly for storing spent nuclear fuels, the criticality calculations conservatively do not account for the reactivity reduction from the fuel burn-up. 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. Accordingly, the criticality calculations of the Interim Spent Fuel Storage Facility are based on the following criteria:

1. With the assumption of total flooding by a potential moderator, e.g. boric acid free water of various densities, the neutron multiplication factor, k_{eff}, as defined by ANSI/ANS-8.17-1984, shall not exceed 0.95.
2. The Interim Spent Fuel Storage Facility shall provide a sufficient safety margin which takes into account the simultaneous occurrence of at least two unlikely and independent condition changes, with respect to the occurrence of criticality accidents.

Calculations were performed to assess the criticality conditions of fuel assemblies being handled in the fuel-handling machine, fuel drying tube, and the storage module. Additional calculations were carried out for those cases where the storage modules or the inside parts of the storage tubes are flooded with water. The criticality conditions were also assessed for various accident situations, e.g. dropping of fuel within the fuel-handling machine, the fuel drying tube, or the fuel storage tube.

The following main safety criteria were satisfied at the planning of the Interim Spent Fuel Storage Facility:

1. The annual individual dose to the operational personnel of the Interim Spent Fuel Storage Facility is below 20 mSv.
2. The distance to the nearest point of the boundary of the controlled zone is at least 100 m, in accordance with the requirements of 10CFR72-106.
3. The dose to the critical group of the population living outside the boundary of the 100 m controlled zone is less than the dose constraint of 10 μSv/y imposed by the authority.
4. No member of the critical group of the population outside the boundaries of the 100 m controlled zone is exposed to a radiation exposure higher than 5 mSv under any design basis accident.
5. The ALARA principle was applied to derive the operational limits of the radioactive material concentration of the discharges and to derive the direct radiation levels during the operation of the Interim Spent Fuel Storage Facility.
6. Operational limits are established to ensure that the radioactive material concentration of the discharges and the direct radiation levels during the operation of the Interim Spent Fuel Storage Facility are within the limits specified in Items 1 and 3, above.

The nuclear safety assessment performed demonstrates that appropriate control of criticality is provided by the Interim Spent Fuel Storage Facility under all normal operational and all assumed off-normal conditions.

In addition to the safety assessment, in 2002 the licensee launched a programme on ageing management. This programme includes the regular inspection and testing of all safety-related systems and system components, beyond the normal maintenance work, and the establishment of a computer database for recording the operational safety parameters of the systems of the facility.

Operation of the facility

The holder of the operation licence of the Interim Spent Fuel Storage Facility is the Public Agency for Radioactive Waste Management. The operational and maintenance activities are performed by the staff of Paks Nuclear Power Plant, in the framework of a contract. The Public Agency for Radioactive Waste Management controls the operation and maintenance work.

The operation licence issued by the Hungarian Atomic Energy Authority is valid until 31 August 2008. The approval provided by the licence relates to the storage of spent nuclear fuel assemblies (of defined parameters) unloaded from Paks Nuclear Power Plant. Only those spent fuel assemblies are allowed to be loaded into the store for which the safety assessment demonstrates that they will not overheat. This means that the fuel-cladding temperature must not be higher than specified for all normal operational and potential off-normal conditions. The loading rate must not be higher than 500 spent fuel assemblies per calendar year. In the years 2001 and 2002, upon the request of Paks Nuclear Power Plant, a loading rate of 1000 spent fuel assemblies per year was approved by the licensing authority.

Volumes 1-6 of the Nuclear Safety Code, issued as attachments to Governmental Decree 89/2005. (V. 5.), shall apply in accordance with the operation licence in safety related matters to

- the Interim Spent Fuel Storage Facility;
- the systems and system components thereof;
- the activities performed in relation thereto;
- the persons performing such activities.

The operational limits and parameters are included in the Technical Specification of the Interim Spent Fuel Storage Facility. This specification is also approved by the licensing authority.

Quarterly and annual operation and the safety reports shall be prepared and submitted to the authority. The procedure for reporting off-normal events is governed by a separate document. During the operation of the facility no events reached Level-1 or a higher level of the INES Scale in the period covered by the Report.

The environmental licence of the Interim Spent Fuel Storage Facility was issued by the regionally competent Inspectorate for Environment. The licensee is the Public Agency for Radioactive Waste Management. The environmental licence specifies the limit values for airborne and liquid discharges. The procedures for discharge and environment monitoring are included in the Review Procedure issued as an attachment to the licence. The results of the discharge and environment monitoring activities are due to be reported to the authority on a monthly basis.

The design, the 'as-built' and the operational documents of the Interim Spent Fuel Storage Facility are all stored at the Paks office of the Public Agency for Radioactive Waste Management. This organisation is also responsible for the handling and maintenance of the documents.

The safety related information required for licensing the Interim Spent Fuel Storage Facility was presented in the Final Safety Case. Based on operational experience and the safety enhancing measures, the Final Safety Case is subject to revision every year.

The operational limits of the Interim Spent Fuel Storage Facility were approved by the licensing authority. The reports prepared in relation to the operation and to the safety of the Interim Spent Fuel Storage Facility shall be submitted quarterly and annually to the authority. The Environmental Permit of the Interim Spent Fuel Storage Facility was issued by the Environmental Authority. The Environmental Permit specifies the limit values for the airborne and liquid discharges from the Interim Spent Fuel Storage Facility. The results of the discharge and environment monitoring activities are due to be reported to the authority on a monthly basis.

The safety criteria applied to Interim Spent Fuel Storage Facility are in full accordance with internationally accepted principles, protective methods and with the national regulatory limits based on ICRP documents. All real hazards associated with normal operation, anticipated operational occurrences and design basis accidents were assessed before licensing and the results were accepted by every competent authorities.

During the long term dry storage of spent fuel in nitrogen 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 the Interim Spent Fuel Storage Facility will not impose undue burden on future generations.

The spent fuel management in other nuclear facilities (Paks Nuclear Power Plant, Budapest Research Reactor) - as demonstrated in Annex 8 - is in accordance with the national legislation. The design and operation of these facilities is in line with the requirements contained in the Convention, as proven also by the findings and results of the safety assessments.

For the four units of Paks Nuclear Power Plant further details related to these issues are contained in the third Hungarian National Report under the Convention of Nuclear Safety, that can be downloaded from the homepage of the HAEA (www.haea.gov.hu).

It can be stated that the practice of spent fuel management complies with the requirements specified in Articles 4-9 of the Convention.

G.2 Disposal of spent fuel

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 that preparations should be made to construct 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 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.

***

In conclusion, it can be stated that the Republic of Hungary fulfils the obligations specified in Article 10 of the Convention.

SECTION H. SAFETY OF RADIOACTIVE WASTE MANAGEMENT

The general safety requirements of radioactive waste management are described in *Section E*. This present section deals with the past practice of radioactive waste management as well as with the safety of the only repository in operation in Hungary, the Radioactive Waste Treatment and Disposal Facility. Finally, the safety aspects of the establishment of a new LLW/ILW repository are discussed.

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.

The spent sealed radioactive sources were placed into storage tubes covered by shielding tubes. Three tubes were placed into one storage-well. Sand filling occupied the space between the tubes. The wells were temporarily closed by a padlocked cover shielded with lead. After they had become full they were closed in the same way as the storage of solid waste. The inventory consisted of waste from isotope applications. The main contributors with half-lives exceeding 30 days were 310 TBq of ^{3}H, 4 TBq of ^{90}Sr, 4 TBq of ^{226}Ra and 2 TBq spent sealed radioactive sources. The estimated total activity amounted to about 400 TBq.

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. As a result of the uranium mining and ore milling about 10 Mt of waste rock, 7 Mt of rock from heap leaching, and 20 Mt of tailings got into the environment in Hungary. 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.

***

In conclusion, it can be stated that with regard to the Solymár site and to the closed uranium mine the results of the past practice were reviewed and the necessary intervention took place in accordance with the obligations specified in Article 12 of the Convention.

H.2 The Radioactive Waste Treatment and Disposal Facility

Assessment of safety and safety upgrading

During the construction phase the safety of the facility was not the subject of any comprehensive assessment. Therefore, in the licensing process for extending the capacity of the repository, on the initiation of the Hungarian Geological Survey, only temporary operational licences were issued.

The various safety assessments carried out between 2000 and 2004 were aimed at determining whether the long-term safety of the site is ensured, or whether corrective measures are needed through which the required level of safety could be guaranteed.

In these assessments, effective doses were calculated for given scenarios. The general objective was to develop models that represent the system as realistically as possible. In cases when the current level of understanding made this impossible, conservative assumptions have been made. The guidance of the ICRP was followed in terms of the definition and living conditions of critical groups.

Although for more than 20 years it has been operated safely, the Radioactive Waste Treatment and Disposal Facility is considered to be unsuitable for some of the waste previously disposed of in the facility. The results of the safety assessments clearly indicate that the spent sealed sources could impose high doses to individuals who intrude into the facility and they could also lead to high doses following any future disruption of the facility by natural processes. Based on the findings of the safety assessments, consideration had to be given to the following:

- the retrieval of certain types of waste from the site and their removal to an interim store, or to a geological repository;
- remedial measures to improve the safety of the wastes that are currently disposed of;
- the disposal of further wastes by providing free capacity within the existing facility.

The basis for optimisation from the point of view of radiation protection is the balancing between the actual doses associated with intervention activities and the reduction of the potential dose in the future. The future decisions on the Radioactive Waste Treatment and Disposal Facility will be based on feasibility/optimisation studies.

The performance assessment calculations undertaken for closure of the existing repository and the implications of such developments to post-closure safety should also be examined.

It is envisaged that the results of the safety assessment be used to define the subsequent research programme and to identify issues that require further consideration.

According to the plans of the Public Agency for Radioactive Waste Management the repository will be operational for a further 40-50 years for accommodating radioactive waste from the country's small-scale producers. By the end of this period, a deep geological repository is planned to be available to accommodate those long lived wastes that are temporarily stored in the Radioactive Waste Treatment and Disposal Facility and that are not amenable for disposal in a near-surface repository. Bearing this approach in mind, the first measures to be taken were those relating to the provision of additional disposal capacity within the site.

Hungary offered the Radioactive Waste Treatment and Disposal Facility as a case to be studied for the new International Atomic Energy Agency Co-ordinated Research Programme. The Hungarian programme is fully in line with the objectives of the new Co-ordinated Research Programme "Application of Safety Assessment Methodologies for Near-Surface Radioactive Waste Disposal Facilities".

Refurbishment

Since its commissioning the repository has been operated without any accident or significant release of radioactivity to the environment. 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 impaired. One of the objectives regarding the development of the Radioactive Waste Treatment and Disposal Facility has been to upgrade the physical state of the facility and to provide better conditions for its further operation. Between 2001 and 2004 the main areas of the upgrading activities were the following:

- physical protection (new fence system, new access control, new equipment for the security guards);
- radiation protection (replacement of obsolete measurement devices, enhancement of environmental monitoring);
- data acquisition (new data recording system, waste characterisation capability, new meteorological station);
- transportation (new transport vehicles and containers).

The list of repairs, improvements, and modernisation activities that have been and are being 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; upgrading of the fire-fighting system.

The other main objective of development at the repository site is to convert the existing building into a centralised interim store for institutional radioactive wastes which are not suitable for near-surface disposal. Although the building was originally designed in the 1970s to treat and condition low- and intermediate level radioactive waste from isotope applications, it remained unused. In the basement of the building special wells (boreholes) were prepared for the storage of spent sealed radioactive sources. The centralised interim store can also serve as a 'buffer storage' especially if an urgent need were to arise for accommodating a comparatively large amount of waste at the repository site.

During the preparations for the capping of vault row No. III (for the description of the repository see *Annex 2*), it was discovered that structures (gutters, asphalt surface, and concrete support) in the near vicinity of the vaults had deteriorated to a considerable extent in the previous few years. Although the safety of the repository was not jeopardized, damage to the precipitation drainage system and subsidence of the road pavement endangered the long-term safety of the final cover (capping). The reconstruction of the vault rows No. III and IV, that did not involve opening of the vaults containing radioactive wastes, was successfully completed.

H.3 Siting of a new LLW/ILW repository

The disposal capacity currently available in the Radioactive Waste Treatment and Disposal Facility is sufficient for disposing of the radioactive wastes produced in research, medical and industrial institutions for several years. For LLW/ILW coming from the operation and decommissioning of the nuclear power plant a new facility should be built. During the planned 30 years of NPP operation and decommissioning the production of altogether about 20 000-40 000 m^3 LLW/ILW can be anticipated.

In 1993, on the initiative of the then operative Hungarian Atomic Energy Commission, the Government launched a national programme aimed at selecting a site for the disposal of LLW/ILW arising during the operation and decommissioning of the nuclear power plant.

According to the principles that had earlier been set out, alternative solutions had to be examined both in terms of location and the mode of disposal. Thus both near-surface and underground repositories at up to 300 m depth were considered. Bearing in mind the international recommendations, the principle was adopted that safety of the repository should be guaranteed by a combination of waste form and packaging, engineered barriers, and the geological environment.

Site selection process

The site selection process was directed by the Geological Institute of Hungary. Initially, 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. Of these, four prospective areas (three for near-surface and one for underground disposal) were investigated by field reconnaissance. Boreholes were drilled at two near-surface (loess) sites and one underground (granitic) site. On comparison, the granite site proved to be more suitable. Based on series of investigations, a granite formation in the village of Bátaapáti (in the Üveghuta area) in south-west Hungary was selected as a potential site for an underground repository. One of the potential near-surface sites, in the village of Udvari, was selected as an alternative solution for further investigations, should the investigations in Bátaapáti (Üveghuta) not meet the expectations.

Safety analyses of the planned repository

Up till now, the Hungarian radioactive waste disposal regulations have not adopted risk-based standards. However, in making preliminary judgement on the suitability of sites under consideration - with different repository designs and in different geological settings - probabilistic performance assessment was used. As in other radioactive waste programmes world-wide, the applied health risk (corresponding to stochastic effects) was 10^{-6}/year risk increment for potentially exposed people.

A preliminary safety assessment for the Bátaapáti (Üveghuta) site has been prepared in co-operation with Belgian and Finnish institutions within the framework of a PHARE project initiated in 1998. This assessment focused on scenarios that did not include any disruptive event (the normal evolution scenario). Extreme or disruptive events (climatic change, undetected fault leading to the surface, failure of the backfill or seals) were considered in separate scenarios. In addition, inadvertent human intrusion was considered on the basis of possible exploration boreholes drilled into the disposal area.

Concentrations of radioactive isotopes calculated for the vicinity of the disposal areas do not exceed significantly the concentrations existing in the natural environment. To calculate the concentrations in the biosphere one has to investigate the effects of transport (delay, dilution and dispersion) through the geological formation. Results of the hydrodynamic modelling show that groundwater velocities at depths of 250-280 m are a few centimetres per year. Results of the preliminary safety assessment of the Bátaapáti (Üveghuta) subsurface disposal facility illustrate that radiological risk to the public is negligible for the post-closure phase (doses to the public are several orders of magnitude lower than the authorised limits for every case considered). This statement is valid for the normal and altered evolution scenarios. By virtue of the deep location and the hydrogeological conditions at the site, the proposed concept of subsurface disposal is not affected significantly by changes in the environment.

In that some Hungarian experts expressed reservations concerning the adequacy of the site investigations, in 1999 - at the request of the Hungarian Atomic Energy Authority - an international expert mission took place in the framework of the Waste Management Assessment and Technical Review Programme (WATRP) of the International Atomic Energy Agency. The mission concluded that the process that led to the selection of the Bátaapáti (Üveghuta) site appeared reasonable and it had appropriately considered the aspects of both geology and public acceptance. It therefore appeared that the Bátaapáti (Üveghuta) site was potentially suitable for developing a safe repository for the disposal of low and intermediate level operational and decommissioning wastes from nuclear power generation.

Since early 2002, the research and exploration work has continued on the basis of these opinions and proposals.

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, 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 are 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 (Üveghuta) site utilising the most up-to-date techniques. To this end a considerable amount of information - necessary for the design and licensing of the repository - was used, that had been gained through research and investigation. 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.

In terms of the Environmental Impact Study, the environmental monitoring of the site has been continued.

Current activities

By October 2004 the special authorities had issued all the licences necessary for shaft driving. Underground geological exploration in the granite block qualified as suitable is aiming at defining the location of the repository. In the coming years, two inclined shafts each with a cross-section of 26 m^2 will be driven extending to a length of about 1700 m. In May 2005 the respective lengths of the tunnels had reached 120 and 150 m.

For licensing purposes, further geological investigations a preparatory activities as well as safety assessments are required. During the authority licensing process, quite a number of approvals are needed in order to obtain the construction license.

On the basis of the available investigation results, the facility would be constructed on the outskirts of Bátaapáti village (in the Üveghuta area) at a depth of 200-250 m below the surface, at 0-50 m above sea level. The exact location of the disposal area will be defined after additional geological investigations and experience gained during the mining exploration. Layout of the subsurface facility is affected by the geological environment and by the amount of waste. At present, a chamber-type arrangement seems favourable. Both the waste drums and the disposal containers would be placed in the disposal areas (expectedly horizontal, large cross-section chambers) so that any radioactive isotopes escaping from the waste packages after a long time would be sorbed by the clay (which contains bentonite) backfill material either around the waste packages or inside the containers. Thus the probability of a significant release of radioactivity would be very low, even after several hundred years. It is considered that the backfill would limit access of groundwater to the waste packages. Design of the layout and of the characteristics of the disposal areas will need to be refined after further geological investigations (design as you go).

***

In conclusion, it can be stated that the Republic of Hungary fulfils the obligations specified in Articles 11-17 of the Convention.

SECTION I. TRANSBOUNDARY MOVEMENT

With respect to the transboundary movement of radioactive waste, Hungary promulgated Governmental Decree 155/2004. (V. 14.) on the licensing of shipments of radioactive waste across the national border. The Decree is in concordance with Council Directive 92/3/EURATOM of 3 February 1992 on the supervision and control of shipments of radioactive waste between Member States of the European Union and into and out of the Community.

The Hungarian Atomic Energy Authority is the competent body for licensing shipments out of Hungary and to give consent to shipments into Hungary. In these undertakings it is supported by the Office of the Chief Medical Officer of the National Public Health and Medical Officer Service and the Headquarters of the Police, as special authorities.

The decree 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.

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.

***

In conclusion, it can be stated that the Republic of Hungry has regulated the transboundary movement of radioactive waste in compliance with the provisions of Article 27 of the Convention.

SECTION J. DISUSED SEALED SOURCES

All practices involving radioactive materials, including sealed radioactive sources, are subject to licensing as required by Decree 16/2000. (VI. 8.) of the Minister of Health in order to ensure safety. All radioactive sources are recorded in a central registry, handled by the Institute of Isotope and Surface Chemistry on behalf of the Hungarian Atomic Energy Authority. The central registry system has been in operation since the end of the 1960's, and it provides for the regulatory control of radioactive sources throughout their full life-time. This registration system was recently upgraded on the basis of the new Decree 33/2004. (VI. 28.) of the Minister of Internal Affairs. 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 which contains all relevant technical data as well as details of the legal owner of the source. The new system has strengthened the regulatory control, and greatly improved its efficiency.

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 times. 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.

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.

***

In conclusion, it can be stated that the Republic of Hungary fulfils the obligations specified in Article 28 of the Convention.

SECTION K. PLANNED ACTIVITIES TO IMPROVE SAFETY

K.1 The Interim Spent Fuel Storage Facility

The design work of the Interim Spent Fuel Storage Facility was performed in the 1990's, 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 existing storage modules of the facility, mention is made of the improvements to the physical protection, and the modernised monitoring of the emissions and the environment. The container service building, the refuelling machine and the radiation protection control system have been improved, too. Among the technological upgrades the modifications on the fuel machine ventilation and the nitrogen supplying systems should be mentioned. The modifications facilitated the operation of the installation, thus they improved the operational safety.

The construction of four more new modules (Nos. 8-11) of the Interim Spent Fuel Storage Facility was completed by the end of 2002. In 2003 the 8th module was given its operational licence for storage, in 2004 a further three modules (Nos. 9-11) were licenced for storage. This work means that the first significant stage of construction has now been completed, since the most important licences of the Interim Spent Fuel Storage Facility have been issued for the 11 modules constructed so far.

In 2004 a new procedure started to license the further enlargement, i.e. the construction of modules 12-16, in order to have it ready by 2007. Compared with the existing modules, modifications have been made in the construction of the leakage monitoring system and the nitrogen supply system.

After the fuel 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, the licence was issued to store these fuel assemblies in the Interim Spent Fuel Storage Facility.

In the framework of the new licensing procedure for enlarging the facility, a modification of both the environmental and the site licence was issued. Prior to commencing the construction work, a construction licence is needed.

The enlargement of the facility will thus continue with the establishment of the next five modules, in line with the main features of the original plans. In parallel, the elaboration of the licensing documentation of a new technical solution, modifying the original concept, started, as a means of preparing for the possibility of a change-over to a new, container type storage facility. Any decision on the type of the further enlargement - due after 2007 - will be based on a complex evaluation under the same safety requirements.

K.2 The 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.

Based on the safety assessments conducted, it has been adjudged that long-term safety of the Radioactive Waste Treatment and Disposal Facility may be assured with appropriate measures.

Thus in the mid-1990's Hungary started systematic work on the safety upgrading of the Radioactive Waste Treatment and Disposal Facility. Between 1996 and 2002 the safety re-evaluation of the repository was the primary focus, together with some basic modernisation and refurbishment measures, as well as supplementary site investigations as described in *Section H*.

In 2002 a project was launched to select the most appropriate and acceptable methods for enhancing safety and to make the necessary preparations for the remedial measures. Important elements of this programme include construction of the central interim store, waste inventory re-evaluation, a feasibility study, a detailed work programme, and preparations leading to licensing.

Key recommendations, based on the present results of the safety assessment, are:

- certain long lived and high activity spent sources should be removed from the facility;
- the repository caps should be designed with exceptional care; this is a key element of the system from the safety perspective;
- any long-term settlement within the vaults should be minimised and at an appropriate time the vaults should be completely backfilled;
- steps should be made to minimise the chances of future human disturbance by recording information about the facility and by an appropriately extensive period of administrative control over the site.

Possible developments at the site could include:

- remedial measures to improve the safety of the wastes that are currently disposed of;
- the retrieval of long lived and high activity spent sources from the site and placing them into an interim store pending final disposal in a geological repository.

The modifications might include, for instance, complete backfilling of the vaults to provide an additional chemical and physical barrier to migration and potential intrusion. Alternatively, the modifications might specify a longer period for institutional control to prevent inadvertent intrusion for a specified period of time.

Recovery of wastes, in the first place the recovery of long lived spent sealed sources and their disposal elsewhere, may reduce the possibility of high radiation doses. Only if the technology for treatment and the storage capacity for the recovered wastes are available can recovery operations be started. For wastes not amenable for near-surface disposal, long-term storage needs to be ensured. To avoid accidents or exposure during recovery, painstaking planning and preparation are essential.

It is envisaged that the planned reconditioning and repackaging will improve local physical containment, provide a chemical barrier, and offer the possibility of volume reduction.

In the case of the wastes from vaults that have not been backfilled with concrete, retrieval would be relatively easy compared with the backfilled vaults, where safe retrieval of spent sealed radiation sources would be considerably more difficult and risky. Removal of spent sealed radiation sources from the 6 m deep disposal wells is a separate task for intervention activities.

During the safety enhancing and modernisation activities, in addition to using its own resources and expertise, Hungary has been relying on external assistance and collaboration.

A feasibility study financed by the European Union PHARE project was completed in 2004, investigating in detail those possibilities by which, when applied, the long term safety of the repository can be assured. While investigating the possible corrective measures, the risk of present and future interventions had to be taken into account also bearing in mind other aspects, such as the need to set free additional capacity for the disposal of future institutional waste.

According to the operator's intention within a demonstration programme four vaults will be opened with the aim of testing the technologies and methods to be used and identifying the potential disadvantages. Based on the results of this demonstration, the final procedures and requirements can be determined.

The first step is to develop a conceptual plan from the strategy, and to start compiling the licensing documentation. This work is now in progress. In accordance with the plans the first demonstration programme for the safety enhancing intervention can start in the first half of 2006.

For the practical implementation of the safety enhancing programme it is envisaged that further international assistance – within the framework of the IAEA Technical Co-operation Programme – should be used.

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 cask 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/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 module is capable of accommodating 450 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 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.

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, every 5th year the sealing of 4 randomly selected closure plugs are removed and investigated by destructive material testing.

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. It is a self-regulating system in that as more heat is given up to the cooling air which rises up through the discharge stack, more air is drawn into the module by the thermosyphoning effect, thereby ensuring adequate cooling without the need for any active mechanical systems or human intervention.

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 access system is designed to prevent uncontrolled access of persons and/or vehicles and to warn the security staff of any attempt to trespass. The system's computer registers all entries of persons and vehicles to the site. Vehicle access by road to the Interim Spent Fuel Storage Facility from the nuclear power plant site is not possible. This can only be done through the access point of the security system. Transport of the spent fuel assemblies is carried out under strict control from one facility to the other.

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. Most of the laboratory inspections are performed by the health physics laboratory of the Interim Spent Fuel Storage Facility. The discharges from the storage are very small: in 2004 the amount of discharges was only 0.0012% 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. A sampling station, equipped with telemetric devices installed next to the site, has been integrated into the similar system of the power plant. Environmental dose rate monitoring, aerosol activity concentration measuring and aerosol/fall-out sampling functions are fulfilled by this station. The entire network, together with the meteorological data obtained by the power plant's meteorological monitoring system, enables dispersion model calculations to be completed for various discharges. 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.

Up till 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 $3x10^{-5}$ μSv/y annually; in other words, orders of magnitude less than the dose constraint (10 μSv/y).

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. To the SW the ridge is bounded by the small river Némedi, and to the NE by the small river Szilágyi. 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 a typical near-surface engineered facility consisting of reinforced concrete vaults and steel-lined wells.

The vaults and wells are located above the water table in the unsaturated zone within a 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 four areas in order that different types of wastes can be disposed of separately. The disposal units are, accordingly, categorised into 4 classes, abbreviated by the letters ‘B’ and ‘D’ for wells and by ‘A’ and ‘C’ for vaults.

The type ‘A’ disposal unit consists of 60 vaults each of 70 m^3 and six vaults each of 140 m^3. The vaults are arranged in four rows (No. I-IV). Initially, both unconditioned and conditioned wastes packaged in plastic bags or metal drums were placed in the disposal cells and grouted in-situ; at first, grout, later concrete prepared with low activity waste water was used. This practice was later changed whereupon inactive concrete was used. To enable retrieval of the waste drums in the future, the practice of grouting is no longer followed.

Nowadays, all wastes are conditioned and packed into drums or containers.
Two clusters of vaults have already been sealed and temporarily covered. After filling up a single vault, the upper insulation is completed in the following way:

- a 15 cm thick inactive concrete layer covers the waste packages in the backfilled vaults;
- 19 cm thick prefabricated reinforced concrete panels are placed on the top of the vault;
- a gently sloping (approx. 1%) cementitious mortar layer of 5-10 cm is created;
- water-insulation is ensured by a bitumen layer of 0.5 cm, bitumen impregnated textile, and a 1 cm layer of sand;
- a 20 cm thick concrete layer protects the water-insulation;
- a temporary clay cap of 2 m thickness covers the insulated vault; a 15 cm layer of topsoil is then deposited on top and seeded with grass.

Type ‘C’ vaults are used for the disposal of contaminated organic solvents having an activity above the relevant exemption level for incineration. Prior to disposal, liquids are cemented or sponged up with siliceous marl at the waste production site. This material is normally placed in metal cans or drums for disposal.

This disposal 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. In the past, the storage of special spent sources, such as ^{239}Pu, ^{226}Ra, ^{99}Tc, and ^{14}C from the isotope producers was an issue of concern. Currently, Pu sources are collected and stored by the Institute of Isotopes and Surface Chemistry. Radium sources were previously collected and stored at the National Institute of Oncology. In 2001 the Ra sources from medical use were encapsulated and shipped to the Radioactive Waste Treatment and Disposal Facility for interim storage.

The type 'D' disposal 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 have been utilised for disposal of spent radiation sources with a half-life of greater than 5 years. One of the wells is kept for the interim storage of very long lived sealed sources. These are only temporarily stored at the site.

An2.2 Handling and Storage

Drummed wastes are loaded into the repository with a crane, layer upon layer.

Spent gamma sources are not conditioned prior to disposal into the stainless steel wells. The wells are partially filled with cement grouting up to the level of sources usually twice a year. The wells have an active depth of 5 m because the 1 m part at the top remains unfilled so that it can be cemented when closing the individual well to provide the necessary radiation protection at the surface. During the operational phase the wells are protected by a lead plug.

Spent alpha and beta sources are embedded into cement before being disposed of with the other LLW/ILW in type 'A' disposal units.

The operational building was originally designed for radioactive liquid waste treatment. However, the volume of waste to be treated was so low (about 20 litres per year) that the equipment was never used. At present these wastes are, as referred to in the previous point, sponged up with siliceous marl or cemented at their production site when taking over the waste.

Reconstruction of the Operational Building was accomplished in 2003. The basement of the building serves as interim storage for long-lived radioactive wastes that are not suitable for disposal at the site. Also in the basement, space is provided for storage of nearly one thousand 200 l drums. A separate storage room is designated for nuclear materials. Furthermore, 50 wells were also sited here for storing long-lived spent sealed radioactive sources.
Repackaging of the incoming waste and its preparation for storage will be performed at the ground level of the building.

An2.3 Transport, disposal and record keeping

The transport of radioactive waste from waste generator to site and on-site is organised by the Public Agency for Radioactive Waste Management under its own responsibility, using its own work force and equipment.

Large gamma sources are usually sealed into a special disposal container by the Institute of Isotopes Co. Ltd. Gamma sources with no surface contamination are not packaged. For their safe transportation lead containers are used. Alpha and beta sources are packed into polyethylene casings. For neutron sources paraffin protection is used, as necessary. Other types of waste are shipped to the facility in drums.
If treatment is required prior to disposal, then the waste is temporarily stored. The types of wastes needing treatment include organic solvents, biological waste, contaminated water, damaged or damageable spent sources. Treatment may be solidification, sponging up of liquid by absorbing material or repackaging.

At present only waste packed in metal drums or containers is disposed of in the type 'A' disposal unit.

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 has a waste inventory record keeping system. Originally the record keeping system was based on paper documents, but during the 1980's the old system was replaced by a computerised database. The record keeping system was recently upgraded (1999). The new waste inventory record keeping system was designed in accordance with international recommendations (IAEA-TECDOC-1222: Waste inventory record keeping systems for the management and disposal of radioactive waste). In parallel with the development of the new waste inventory record keeping system, a major revision of inventory data was carried out, which also included a critical review of all existing old information (paper documents as well).

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 of radioactive materials, and also submits to the registry annual reports on the volume and radionuclide inventory of bulk waste disposed of.

An2.4 Guarding

The access control system, as part of the refurbishment programme, was installed in 2001. The site is guarded by well-equipped security guards, applying up-to-date security systems. The access control system ensures that only licensed 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. The access control system is designed to prevent uncontrolled access of persons and/or vehicles and to warn the security staff of any attempt to trespass. 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

Tight radiation protection control begins already at the waste producers when receiving the waste. Surface dose rate and contamination of the packages are regularly measured. The transport vehicles are subject to radioactive contamination and exposure control. The exposure of personnel is measured by two different types of personal dosimeter.

Prior to start-up of the repository (between 1974 and 1976) the basic radiological levels (so called zero levels) were determined, based on the guidelines of the authority. These levels serve as reference values to interpret the results obtained during the operation of the repository.

The radiological status of the site is continuously monitored; the stringent rules and limits set for discharges are regularly checked by the competent authorities. Installed and portable devices measure the dose rate near the vaults and wells, as well as the surface contamination at the site. All signals of the installed detectors are centrally processed and displayed. The monitoring system was planned and installed to provide information and data about the radiological conditions of the repository and its environment.

Meteorological data are collected by a special station. The water collection system is designed to collect run-off and is routed to two large basins. The radioactivity of the collected water is sampled and monitored before being discharged via a drainage ditch to a local stream. The water samples are also checked by the authority.

Analysis of water samples taken from the observing wells is also an important part of the monitoring programme. In December 1999, elevated tritium concentrations of about 300 Bq/l were measured in an on -site observation well on. A special investigation programme was set up and in the framework of this programme several new wells were drilled to monitor the ground water; the frequency of sampling has been increased, a tracing test was carried out and some structural investigations took place. Based on the results of these investigations a proposal was made to pay special attention to the hermetic sealing of high activity, tritium containing waste (targets, sources) in course of the activities of waste retrieval (for safety enhancement and provision of free storage capacity) in order to ensure a decrease in the possibility of eventual leakage.

Soil-, flora and fauna samples are taken from the site as well as from the 20 km vicinity of the repository. Analysis of fish samples taken from a nearby pond is also part of the environmental monitoring programme. Radioactivity of flesh, bones and the pluck of sheep and goats grazing in the vicinity of the site is regularly measured. Processing and measurement of the samples takes place partly at the local laboratory, partly at external laboratories.

The facility is regularly inspected by the competent authority, viz. the Budapest Capital Institute of the National Public Health and Medical Officer Service. During inspections, the authority supervises the site itself and does sampling in the vicinity of the site.

The environmental monitoring system was reconstructed between 2000-2001 by replacing obsolete equipment and adding some new checking points.

Practically all elements of the environment of the storage facility are investigated according to the annual sampling schedule approved by the authority. Any possible changes can be evaluated by comparing the data with the results of the pre-operational activity concentrations given below:

- water 7×10^{-5} - 6×10^{-4} Bq/g
- mud/soil 0.2 - 0.9 Bq/g
- plant 5 - 9 Bq/g ash
- fish ~ 3 Bq/g

The results of environmental monitoring, confirmed also by the regulatory authority, prove that there has been no elevated radioactivity level in the environment of the Radioactive Waste Treatment and Disposal Facility.

ANNEX 3: ISOTOPE COMPOSITION OF LLW/ILW

The inventory of radioactive waste - as described in *Section D* - consists of two major components in Hungary:

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

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 two facilities.

An3.1 The 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 2004. Isotopes with half-lifetime 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	Vaults*	Wells*	Sum**
^{3}H	2.23E+14	2.31E+12	2.29E+14
^{14}C	5.63E+12	7.38E+07	5.63E+12
^{60}Co	1.55E+12	6.31E+14	6.63E+14
^{85}Kr	2.21E+11	6.18E+09	2.41E+11
^{90}Sr	3.52E+13	2.24E+11	3.54E+13
^{99}Tc	9.61E+09	1.71E+05	9.61E+09
^{137}Cs	6.91E+12	2.26E+12	9.18E+12
^{210}Pb	6.31E+08	4.04E+02	6.31E+08
^{226}Ra	1.74E+11	1.42E+11	3.16E+11
^{232}Th	4.613E+10	0	4.63E+10
^{234}U	7.83E+09	0	7.83E+09
^{235}U	2.59E+08	0	2.60E+08
^{238}U	2.31E+10	0	3.68E+10
^{238}Pu	1.62E+10	5.76E+09	2.53E+10
^{239}Pu	2.77E+12	1.24E+07	2.79E+12
^{241}Am	4.51E+12	2.91E+12	7.42E+12
^{238}Pu-Be	8.48E+11	0	8.48E+11
^{239}Pu-Be	2.50E+09	0	2.50E+09

Notes: * The stored waste are not considered
** Total activity of the wastes both stored and disposed of.

An3.2 Paks Nuclear Power Plant

Table An3.2-1 summarises the average and the highest activity concentrations of radioisotopes measured so far in the various waste streams of the nuclear power plant. The figures were based on measurement results.

Table An3.2-1 Average and maximum activity concentration of radio-isotopes contained in the waste of Paks NPP (Bq/dm^3)

Waste flow	Solid		Concentrate		Resin	
Isotope	**Max.**	**Average**	**Max.**	**Average**	**Max.**	**Average**
^{124}Sb	5.67E+06	3.90E+05	5.00E+04	9.60E+03	N.A.	N.A.
^{58}Co	7.98E+07	3.89E+06	2.30E+06	2.18E+05	6.40E+06	2.40E+06
^{110m}Ag	3.15E+07	1.20E+06	9.70E+05	2.28E+05	5.40E+08	9.80E+07
^{54}Mn	7.23E+07	4.33E+06	1.60E+07	7.57E+05	3.90E+08	1.00E+08
^{134}Cs	5.90E+07	3.06E+06	8.50E+06	2.87E+05	1.30E+08	1.90E+07
^{55}Fe	7.80E+07	2.50E+06	2.70E+07	1.89E+06	8.00E+09	3.36E+09
^{60}Co	1.16E+08	8.67E+06	4.90E+07	1.64E+06	6.30E+07	1.70E+07
^{3}H	NA	NA	6.40E+05	1.66E+05	4.30E+05	9.55E+04
^{244}Cm	1.20E+01	2.00E-02	1.50E+04	6.29E+02	4.20E+04	7.60E+03
^{90}Sr	9.60E+00	1.90E+00	4.20E+05	1.86E+04	6.29E+06	2.59E+06
^{137}Cs	1.08E+08	2.59E+06	5.90E+06	1.02E+06	2.20E+08	4.00E+07
^{238}Pu	2.80E-01	4.20E-02	4.90E+03	2.47E+02	9.60E+04	1.40E+04
^{63}Ni	2.20E+05	1.60E+04	1.90E+06	4.28E+05	1.10E+07	7.00E+06
^{241}Am	8.90E-01	9.60E-02	4.20E+03	2.25E+02	1.80E+04	2.88E+03
^{14}C	2.80E+05	1.50E+04	1.56E+04	6.67E+03	4.30E+05	1.13E+06
^{243}Am	NA	NA	3.00E-01	4.60E-02	6.60E-01	6.60E-01
^{94}Nb	5.80E+05	1.70E+02	3.90E+01	4.60E-02	1.40E+02	1.40E+02
$^{239+240}$Pu	3.90E-01	5.50E-02	3.30E+03	1.91E+02	9.50E+04	1.38E+04
^{59}Ni	2.20E+03	1.70E+02	4.60E+04	8.60E+03	4.50E+05	1.29E+05
^{41}Ca	1.10E+01	5.50E-02	5.50E+01	1.06E+01	1.70E+04	2.50E+03
^{99}Tc	5.60E+00	1.00E+00	7.67E+01	9.88E+00	5.76E+04	1.92E+04
^{234}U	1.20E-02	3.80E-03	2.67E+00	4.43E-01	1.46E+02	4.20E+01
^{36}Cl	2.90E-01	2.10E-02	6.40E+00	2.50E+00	5.07E+03	2.15E+03
^{135}Cs	1.20E+00	2.40E-02	3.70E+00	3.90E+00	1.10E+03	6.90E+02
^{129}I	3.00E-02	1.10E-03	2.17E+03	2.64E+02	1.79E+04	5.13E+03
^{235}U	2.50E-03	8.40E-04	1.20E-01	3.93E-02	2.60E+01	1.32E+01
^{238}U	9.20E-03	2.70E-03	8.11E-01	2.33E-01	5.50E+01	1.65E+01

Notes:
NA: no data available
The "mean values" are the arithmetic mean of the values measured during the period between 1992 and 31 December 2003 (25-110 measurements for each isotope).
The waste streams do not contain the amounts from the incident in 2003 (see table below).
The "Max values" are the highest activity concentrations measured so far.

Table An3.2-2 Calculated quantity and total activity of wastes resulting from the incident in Paks NPP Unit 2 (Bq)

Waste stream	**Solid**	**Concentrate**	**Resin**
Isotope	**400m^3**	**310m^3**	**60m^3**
^{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

Note: The activity values are valid for 2017

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 operational life-time of the nuclear power plant (2017).

The data presented in Table M3.2-3 were based on the quantities below, and were valid up to 31 December 2001:

- Solid waste: 120 m^3/year
- Concentrate: 250 m^3/ year
- Resin: 2.5 m^3/ year

The data were based on the following quantities from 2002 to 2017:

- Solid waste: 160 m^3/ year
- Concentrate: 250 m^3/ year
- Resin: 5 m^3/ year

The data above were established on the basis of quantities generated during the last five years (between 1 January 2000 and 31 December 2004).

The total life-time of the nuclear power plant is taken to be 30 years. 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.

Table An3.2-3 Estimated activity of certain radioisotopes by the end of the operation 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
244Cm	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

Isotope	Solid	Concentrate	Resin	Sum
^{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: NA - no data available

ANNEX 4: LIST OF LAWS RELEVANT TO THE CONVENTION

Acts, Law-decrees

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
Law-decree 9 of 1972	on the promulgation of the agreement concluded between the Hungarian People's Republic and the International Atomic Energy Agency for the application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons, signed in Vienna on the 6th of March in 1972
Law-decree 8 of 1987	on the promulgation of the convention on physical protection of nuclear materials
Act LIII of 1995	on the general rules for the protection of the environment
Act CXVI of 1996	on atomic energy
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
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
Act XC of 1999	on the confirmation and promulgation of the Additional Protocol signed in Vienna on the 26th of November in 1998 in connection with the agreement for the application of the safeguards concerning the treaty on non-proliferation of nuclear weapons, concluded between the Republic of Hungary and the International Atomic Energy Agency and signed in Vienna on the 6th of March in 1972
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

Governmental decrees, decrees of the Council of Ministers

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
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
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
Decree of the Council of Ministers 34/1988. (V. 6.)	on the promulgation of the agreement on co-operation in the peaceful use of nuclear energy between the Government of Hungarian People's Republic and the Government of Canada signed on the 27th of November in 1987
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
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
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
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
Governmental Decree 116/1992. (VII. 23.)	on the promulgation of the agreement on co-operation in the field of the peaceful use of nuclear energy concluded between the Government of the Republic of Hungary and the Government of the United States of America, signed in Vienna on the 10th of June in 1991
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
Governmental Decree 17/1996. (I. 31.)	on the actions in connection with the found or confiscated radioactive or nuclear materials
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.

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
Governmental Decree 213/1997. (XII. 1.)	on the exclusion zone of the nuclear installation and the spent fuel storage facility
Governmental Decree 227/1997. (XII. 10.)	on the type, conditions and sum of the liability insurance or other liability financial coverage concerning atomic damage
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 installations, and on the financial source for performing tasks
Governmental Decree 248/1997. (XII. 20.)	on the National Nuclear Emergency Response System
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
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
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
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
Governmental Decree 20/2001. (II. 14.)	on the environmental impact assessment
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
Governmental Decree 275/2002. (XII. 21.)	on the monitoring of radiation levels and radioactivity concentrations in Hungary
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
Governmental Decree 165/2003. (X. 18.)	on the information to be provided to the public in nuclear and radiological emergencies
Governmental Decree 155/2004. (V. 14.)	on the licensing of shipment of radioactive waste across the national border
Governmental Decree 244/2004.(VIII. 25.)	on the promulgation of the protocol on conditions concerning the reshipment to the Russian Federation of Russian-made (irradiated) spent fuel assemblies

Governmental Decree 263/2004. (IX. 23.)	on the regulation of international trade of nuclear and nuclear dual-use items
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

Ministerial Decrees

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
Decree of the Minister of Construction and City-planning 11/1984. (VIII. 1)	on the rules for constructing nuclear facilities
Decree of the Minister of Transportation, Telecommunication and Water 13/1997. (IX. 3.)	on the promulgation of the regulation on the safe railway transportation of spent nuclear fuel
Decree of the Minister of Transportation, Telecommunication and Water 14/1997. (IX. 3.)	on the transportation, shipment and packaging of radioactive materials
Decree of the Minister of Public Welfare 23/1997. (VII. 18.)	on the exemption levels (activity-concentrations and activities) of radionuclides
Decree of the Minister of Industry, Trade and Tourism 39/1997. (VII. 1.)	on the system of accounting and the international control of nuclear materials and the jurisdiction of certain regulatory rights
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

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
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
Decree of the Minister of Economy 27/1999. (IV. 4.)	on the fees for final disposal of radioactive wastes
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
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
Decree of the Minister of Health 30/2001. (X. 3.)	on the operational radiation protection of the outside workers
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
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
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
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
Decree of the Minister of Interior 33/2004. (VI. 28.)	on the central and local accountancy system for radioactive materials
Decree of the Minister of Interior 41/2004. (VII.7)	on the operation and administration of the Central Nuclear Financial Fund

ANNEX 5: REFERENCES TO OFFICIAL NATIONAL AND INTERNATIONAL REPORTS RELATED TO SAFETY

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

Act CXVI of 1996 on Atomic Energy obliges the President of the Hungarian Atomic Energy Commission to submit an annual report to the Government and Parliament on the safety of nuclear applications in Hungary. According to the executive order of the Act it is the task of the Hungarian Atomic Energy Authority to prepare this report.

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:

- Utilisation of atomic energy;
- State-level framework of safety;
- Nuclear safety;
- Radiation safety and radiation protection;
- Nuclear emergency preparedness;
- International relations;
- Co-operation with the European Union;
- Public relations.

The report for the year 2003 accepted by the Government and Parliament, similarly to the previous reports, concluded that the nuclear applications in Hungary fulfil the relevant safety requirements. A short version of the report is available on the homepage of the Hungarian Atomic Energy Authority (www.haea.gov.hu), and - on request - the Hungarian Atomic Energy Authority can provide a short English version. The presentation of the report of 2004 is in progress.

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 and in 2004. The Reports were favourably taken up in the review meetings. The reports are available on the homepage of the Hungarian Atomic Energy Authority.

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 (IRS and INES) for exchanging information on safety related events. In applying the INES scale the national INES co-ordinator reports all safety-related events above the level INES 1 to the International Atomic Energy Agency.

The licensee of the Spent Fuel Interim Storage Facility, i.e. the Public Agency for Radioactive Waste Management, has to report non-anticipated events to the Hungarian Atomic Energy Authority's duty officer within 24 hours, in accordance with the requirements of the operating licence. Since the year 2000 the reported events have been classified according to the INES scale. Thanks to the good operational experience up till now in the Interim Spent Fuel Storage Facility there has been no significant event to be reported in the IRS and INES systems.

ANNEX 6: REFERENCES TO REPORTS ON INTERNATIONAL REVIEW MISSIONS PERFORMED AT THE REQUEST OF HUNGARY

An6.1 IRRT mission at the Hungarian Atomic Energy Authority

Twice, at the request of the Hungarian Government authorities, International Atomic Energy Agency teams visited the Hungarian Atomic Energy Authority to conduct a mission. In each case, the purpose of the International Regulatory Review Team (IRRT) mission was to review the effectiveness of the nuclear safety regulatory body of Hungary and to exchange information and experience in the regulation of nuclear, radioactive waste and radiation safety. On request, radioactive waste management, decommissioning, radiation protection, and emergency preparedness were reviewed only to the extent of their being under the responsibility of the Hungarian Atomic Energy Authority. The mission was focused primarily on the responsibilities of the Nuclear Safety Directorate of the Hungarian Atomic Energy Authority.

The first review was conducted from 22 May to 2 June 2000. The mission had a positive opinion of the activities of the Authority, and offered suggestions and made recommendations for further development. The review formulated 22 recommendations and 18 suggestions regarding the Authority's activities in order to support improvement; nine good practices were also identified in various fields.

The report of the team is open to the professional and general public via the homepage of the Hungarian Atomic Energy Authority.

To improve its effectiveness and efficiency the Hungarian Atomic Energy Authority elaborated an action plan to address the recommendations and suggestions contained in the first IRRT mission's report.

After the review, the management of the Hungarian Atomic Energy Authority decided to request an assessment of the practical implementation of the recommendations and suggestions after a few years in the framework of a repeated follow-up mission by the International Atomic Energy Agency. The second mission took place on 9-18 February 2003.

In the final report of the review, the situation and the accomplished work were evaluated, and the expert team concluded that the Nuclear Safety Directorate of the Hungarian Atomic Energy Authority had made efforts with regard to each recommendation and suggestion to improve its performance and had made significant steps forward in most areas. Nevertheless the most important outcomes of the follow-up review were the recommendations regarding further action; these were in the form of two new recommendations and four suggestions. Among these the most relevant concerned the need to improve co-ordination and co-operation with the co-authorities and with the special authorities. In addition, five new good practices were identified in the report.

An6.2 After incident expert mission of the International Atomic Energy Agency

In April 2003, a serious incident occured during a fuel cleaning procedure in Paks NPP. Upon the suggestion of the Director General of the Hungarian Atomic Energy Authority, and at the request of the Minister of Economy on behalf of the Government, the International Atomic Energy Agency conducted a review on the regulatory assessment of the incident and on the activity of the operator from the following points of view

- management and quality assurance systems;
- root cause analysis and risk analysis, analysis of human reliability;
- WWER reactor fuel behaviour characteristics, thermo-hydraulics and chemistry;
- regulatory oversights and interface between the regulator and the operator;
- self assessment of the Authority;
- emergency preparedness and planning;
- radiation protection, radiological dose assessment.

The result of the expert mission conducted between 16 and 25 June 2003 is available on the homepage of the Hungarian Atomic Energy Authority (www.haea.gov.hu).

Among the conclusions of the review, it was emphasized that - as a consequence of the release of radioactivity because of the incident, the general public was not exposed to a dose exceeding the annual dose limits specified in the IAEA's Basic Safety Standards

The expert team made several recommendations and suggestions, in order to improve the activity of the operator and the regulator. The report also emphasized that the management of both the Hungarian Atomic Energy Authority and Paks NPP are committed to improving the nuclear safety of the plant; and they would welcome further assistance of the International Atomic Energy Agency to remedy all aspects of the incident and to improve the facility's safety.

An6.3 Follow-up mission of the International Atomic Energy Agency

The International Atomic Energy Agency expert group had a follow-up mission in Hungary from 20 February – 1 March 2005. The team of 9 experts evaluated the progress that had been made by the Hungarian Atomic Energy Authority and the Paks Nuclear Power Plant to implement the recommendations set down in the review report by the international expert mission after the incident of April 2003.

According to the report prepared at the end of the investigations, 34 of the 48 recommendations on the practice of authority had been completed while good progress had been made regarding the other 14.

The final report prepared by the International Atomic Energy Agency is also available on the web site of the Hungarian Atomic Energy Authority, in its original English form, and in Hungarian translation, as well.

An6.4 Reviews conducted in the framework of the PHARE programme

- Management of spent sealed radioactive sources in Central- and Eastern Europe. Institution Building Unit. TAIEX INSTRUMENT, European Commission, 2005
- A detailed study of waste retrieval and disposal options at the Püspökszilàgy Radioactive Waste Treatment and Disposal Facility, Project funded under the European Commission, PHARE Programme (Project Reference HU0111-02).

ANNEX 7: THE REMEDIATION OF THE CLOSED URANIUM MINE

An7.1 Precedents

During the operation of the Hungarian uranium ore mining and milling, six mining plots were established. The plots are located west of the city of Pécs, on the western and southern side of the Mecsek. The special infrastructure of mining needed for the mine opening and ore milling was developed, including the plants, waste rock piles, heap leaching piles, tailings ponds, vertical shafts for mine exploration and ventilation, adits (galleries), air funnels, blasting material storages and other facilities for accessory activities and social supplies.

The mining activity became uneconomical in the eighties and finally the Government declared that uranium industry operations be finished. Production was terminated in 1997. According to the decision, an investment plan for the remediation tasks of the Hungarian uranium industry had been made, and its accomplishment has started on 1 January 1998, according to the relevant governmental resolutions.

Practically speaking, the fulfilment of remediation had gone on according to plan up till the end of 2002, but from 2003 onwards the funds provided by the annual budget acts have been insufficient to allow the completion of work by the planned deadline. The financial arrangement of the state's investment takes place in accordance with Government Resolution 2193/2004. (VII. 29.) (on the tasks related to the abandonment of uranium ore mining in Hungary).

The deadline for completing of the remediation activities defined in Government Resolution 2193/2004. (VII. 29.) is 31 December 2006.

An7.2 Environmental remediation programme

Prior to the mine closure and remediation activities, numerous tasks had to be fulfilled in order to prepare for the successful remediation. The object inventory had to be made, the extent of contamination had to be assessed, the requirement system of regulation – corresponding to the international requirements within the often insufficient Hungarian legal regulations – had to be elaborated, the appropriate remediation solutions and technologies had to be chosen.

An7.2.1 Primary remediation objectives

The remediation objectives to be achieved were defined in the conception plan completed in 1996:

- ceasing or decreasing to the minimum the environmental damages in connection with the uranium ore mining:
  - protecting the Pécs potable water reserve,
  - lowering the harmful effects of the preterit mining and milling on human health to such a degree, that the additional dose received by those working on the re-utilization of objects will remain under the approved limit;
  - long-term control of the effects of contamination sources, ensuring the possibility of intervention if needed;
  - decreasing to the lowest minimum any future damage caused by the mining;
- re-utilization of the areas and facilities of the uranium industry to the optimum extent:

- decontamination of objects according to the above purpose;
- making the infrastructure built for the mining suitable for other purposes,
- creating new jobs through the above mentioned issues;

- defining the costs of the planned finishing of uranium ore production and of the environmental remediation;
- appropriately scheduled, cost-effective accomplishment of the conception plan.

An7.2.2 Radiation protection requirements

Elaboration of the requirements of the regulation practice being the basis for the remediation activity, the relevant Hungarian and international law and standards, the recommendations of the IAEA and the relevant regulation practice of other countries played determinant role. The authorities established the environment protection condition system for the planning and licensing process of the decommissioning and remediation activities in the Environmental Protection License issued by the South Transdanubian Environmental Protection Inspectorate, which is based on the "Environmental impact assessment of the uranium ore mining in the Mecsek Mts." document and the prescription of the Baranya County Institute of the National Public Health and Medical Officer Service for the radiation protection requirements of remedial action.

According to the Environmental Protection License and the prescription of Baranya County Institute of the National Public Health and Medical Officer Service, the following limit values for release and environmental load have to be kept in the course of mine closure and remediation.

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

Rn exhalation	0.74 $Bq/m^2/s$
Rn concentration	background + 20 Bq/m^3
Gamma-dose rate	background + 200 nGy/h
Activity concentration of soil in the upmost 0-15 cm layer in the 15-30 cm layer	 background + 180 Bq/kg background + 550 Bq/kg

Table An7.2.2-2 Radiation protection requirements of 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 upper 15 cm thick layer	backg. + 180 Bq/kg
	Activity concentration of soil below 15 cm depth	backg. + 550 Bq/kg
Inside buildings	Rn concentration	backg. + 30 Bq/m^3
	Gamma-dose rate workplace average 1 m from floor or wall	 backg. + 200 nGy/h backg. + 200 nGy/h
	Fixed alpha contamination (on floor and wall)	0.5 Bq/cm^2

An7.2.3 Dimensions of the remediation programme

The determination of the size of mining objects was a basic requirement to fulfil the remediation tasks as planned. The characteristic features of the main objects and facilities on the mining plots and other sites are the followings:

- volume of underground openings 17.9 Mm^3
- volume of the nine waste rock piles 10 Mm^3
- volume of the two heap leaching piles 3.4 Mm^3
- contaminated industrial areas 44 ha
- volume of the two tailings ponds 16.2 Mm^3

An7.2.4 Overview of the remediation tasks of the Investment Program

The Investment Programme consisted of ten projects. The scheduling of the programme is shown in Table A7.2.4-1.

Table An7.2.4-1 Scheduling of the remediation program

Project title	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Underground mines									
Surface facilities									
Waste rock piles									
Heap leaching piles									
Tailings ponds									
Mine water treatment									

Project title	1998	1999	2000	2001	2002	2003	2004	2005	2006
Restructuring of electr. supply									
Water supply and sewage									
Infrastructure works									
Monitoring, misc. activities									

The decontamination of tailings ponds, the mine water treatment, the environmental monitoring and the connected activities are expected to last for several decades. These tasks will be accomplished within the scope of the after-care programme.

Besides the Investment Programme an other programme entitled “The Health Surveillance of Uranium Ore Miners” initiated by the Committee on Mining of the Hungarian Academy of Science has been carried out for years

An7.3 Post-remediation tasks

The “Investment Programme of the remediation tasks of the abandonment of the uranium industry in Hungary” approved by Government Resolution 2385/1997. (XI. 26.) contained the costs of the so-called long-term tasks (water purification, maintenance, monitoring activities) till 31 December 2002. Since these tasks will remain in the future for environment protection, healthcare and water reserve protection reasons, Government Resolution 2006/2001. (I. 17.) decided about the financing of these works for the period starting on 1 January 2003 and ordered that the funds must be planned in the budget of the Ministry of Economy and Transport, and agreed by the Ministry of Environment and Water Management.

For the long-term success of technical interventions of reclamation and environmental protection purposes carried out according to the plans of the Investment Programme – and according to the authorities’ prescriptions – controlling, monitoring and maintenance tasks should be performed that are of different degree, character and term for each object.

These tasks are divided into two phases depending on the amount and character of the required activities and according to the methodology accepted internationally in the remediation practice:

- the first phase of 5 years, which contains generally wider and more diverse control and more intensive after-care,
- the second long-term phase requires only limited control and after-care as needed.

Environmental monitoring and the environment protecting activities are the two main fields of the after-care jobs. The environmental monitoring includes on-site measurements, sampling and data recording, laboratory analyses, data processing, interpretation and modelling. Informing the authorities and the public is also an important task. One of the purpose of the information of the public is to promote the re-utilization of the areas and to prevent any harmful effects until the remediation works is completed.

For the protection of the environment the following tasks should be accomplished:

- uranium removal from the surface and groundwaters (the capacity of the uranium removal plant is 1.5 million m^3 water annually);

- desalination of groundwaters (treatment of a water volume of 1000-1200 m^3/day);
- maintenance of water purification plants, the decontamination and water discharging systems;
- operating the unified water discharge system;
- maintenance and after-care of areas of limited utilization.

Considerable after-care activities are expected on the tailing ponds; these are the largest and most sensitive objects considering the complexity of the cover layer. Biological reclamation will not be fully completed entirely by the end of the Investment Program since the planting of trees and shrubs will probably be drawn out, depending on the conditions.

ANNEX 8: NUCLEAR FACILITIES, SPENT FUEL ASSEMBLIES, DISCHARGES

An8.1 Paks Nuclear Power Plant

An8.1.1 Management of the spent fuel assemblies

An8.1.1.a 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 of Safety Regulations for Nuclear Power Plants entered into force by Decree 5/1979 (III. 31.) of the Minister of Heavy Industry. 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 Act CXVI of 1996 on Atomic Energy, issued the governmental decree on the proceedings of the Hungarian Atomic Energy Authority. As appendices of this decree, the Nuclear Safety Codes were issued replacing the above mentioned Safety Regulations for Nuclear Power Plants.

Management of the spent fuel assemblies shall meet the requirements of Nuclear Safety Regulations. The functional requirements for tools and equipment of spent fuel management are the following:

a) Criticality shall be prevented by sufficient safety redundancy during the expected operational events and supposed operational failures, even among optimal moderating circumstances, by applying physical tools or principles.
b) Removal of remanent heat shall be ensured in all operational states.
c) Possibility of the drop (or other damage) of a fuel assembly shall be kept to a minimum.
d) Unacceptable mechanical stress shall be prevented in the fuel assemblies.
e) The possibility of any heavy objects falling onto the fuel assemblies shall be prevented.
f) Storage of fuel assemblies with potential or detectable damage shall be solved.
g) During spent fuel management, radiation protection shall be ensured.

An8.1.1.b Systems managing spent fuel elements

Storage of spent fuel assemblies

Spent fuel generated during operation of the nuclear power plant shall be ad interim stored before 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) pool located in the near vicinity of the reactor. An independent spent fuel pool belongs to each of the four reactors.

According to the Construction Designs of the Plant, the spent fuel assemblies, after three years of storage would have been shipped back to the Soviet Union. Later the duration of storage preceding the reshipment was doubled by changing the grid distribution of the original storage structure to a high density one. The first spent fuel reshipment took place in 1989. In order to overcome the problems that arose at the beginning of the 90's with the reshipment a decision was made in 1993 on implementing interim storage in the vicinity of the plant: the Interim Spent Fuel Storage Facility. At present, following the storage in spent fuel pools the spent fuel assemblies are delivered to the Interim Spent Fuel Storage Facility thereby freeing the necessary storage capacity in the pools for the continuous operation of the reactors.

In the spent fuel pools 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 pool, it can be used for storing the spent operational fuel elements, control rods, followers and hermetic claddings, respectively. 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 corrosion–resistant steel with 1.05 – 1.25% boron content ensuring sub–criticality. Hermetic claddings are for storing of fuel assemblies that became inhermetic during operation. Spare "racks" are available for each spent fuel pool, in case the whole reactor core should be emptied.

Handling and transport equipment of spent fuel assemblies

Handling equipment is used to move and - if necessary – to check the spent fuel assemblies as well as to prepare for their transport out of the plant after the cooling period.
The design basis of tools and equipment for handling of fuel assemblies ensures the removal of remanent heat, the maintaining of sub-criticality, the biological protection of the personnel and the minimization of possible injures during operation.
Judging from experience, there is enough storage space in the spent fuel pools for storing leaking fuel elements in hermetic claddings.

Removal of the remanent heat

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

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 remanent heat):

a) Highest initial enrichment: 3.82 %,
b) Maximum 46 GWday/tU average fuel burn-up,
c) 50 GWday/tU highest fuel burn-up,
d) Maximum four - year fuel cycle;
e) Hermetic state of the fuel elements.

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. Thus, sub-criticality of fuel elements stored in the spent fuel pool is ensured by the design/construction of the storage racks. Both storage racks 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 frequency of fuel handling manipulations, no seismic event grater than that with a ground surface acceleration of 0.25g and a site – specific response spectrum was assumed simultaneously with re-fuelling and transport activities.
- 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.

An8.1.1.c 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 pools. Maximum storage capacity of the spent fuel pools amounts to 1052 assemblies for each unit. Spent fuel elements – after a decay period of at least 3 years – are handed over to the Public Agency for Radioactive Waste management (PURAM), for a further intermediate storage of about 50 years in the Spent Fuel Interim Storage. As for the final disposal, the strategy “wait and see” has been followed. The compliance with this strategy is ensured because the capacity of the Spent Fuel Interim Storage can be expanded as required.

An8.1.1.d Consequences of the incident of April 2003

The incident that occurred on 11 April 2003 at Unit 2 is described in the third National Report of Hungary prepared in the framework of the Convention on Nuclear Safety.

Removal of the damaged fuel from the refuelling pond could be accomplished only with special equipment and manipulators. Their design, licensing, manufacturing and the training of the personnel is in progress. The removal – involving Russian institutions – is expected to take place at the beginning of 2006. In this process, damaged fuel material will be placed into casings designed to store the fissile debris. These casings are dimensioned so that they can be placed into the storage positions in the spent fuel pool.

Measurements on the undamaged but - due to the incident - surface-contaminated fuel assemblies from the spent fuel pool and reactor vessel at Unit 2 were accomplished during their transfer into the Interim Spent Fuel Storage Facility. They verified that the disposal of these spent fuel assemblies in the Interim Spent Fuel Storage Facility does not increase the emissions significantly.

An8.1.2 Discharges

An8.1.2.a Regulatory framework

A new dose constraint entered into force in 1998. Consequently, the limit value for the additional dose corresponding to the operation of the nuclear power plant has been restricted to a value of 90 μSv/year with respect to the critical group of the population. Previously the limit values concerning the discharges of airborne radioactive materials were included in Regulation 1/1980. (II. 6) issued by the President of the National Environmental Office on rules for air protection in relation to the nuclear power plant (Table An8.1.2a-1), while the limit values for liquid radioactive discharges were included in the licence No. 20/1989 issued by the Middle-Transdanubian Directorate for Water (Table An8.1.2a-2). These limit values had not been derived from the primary dose limit of the excess radiation exposure of the population.

The Decree 15/2001. (VI. 6.) of the Minister of Environment prescribed generic isotope-selective limitation derived from the dose constraint. 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 the discharge pathway “j” (Bq/year);

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

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

In order to comply with the regulatory restriction, the Decree 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 specified in the Discharge Monitoring Code.

Table An8.1.2.a-1 Regulatory limits concerning the airborne radioactive discharges of Paks Nuclear Power Plant up till 2003

RESTRICTION FOR AIRBORNE DISCHARGES [Bq/day] for a power of 1000 MW_e	
Radioactive noble gases	1.9×10^{13}
Radioactive aerosols	1.1×10^{9}
Radioactive iodine isotopes	1.1×10^{9}
^{89}Sr and ^{89}Sr	5.6×10^{4}

- The values included in the Table pertain to an average of 30 days.
- The discharge limit concerning the radioactive aerosols pertains to isotopes having a half-life of more than 24 hours.
- The limit value concerning the discharge of radioactive iodine isotopes shall be specified in an equivalent of ^{131}I.
- In the case of simultaneous boron control of two units, maximum permitted discharge of radioactive noble gases is 6.5×10^{13} Bq/day under a frequency of one per week.

Table An8.1.2.a-2 Regulatory limits concerning the liquid radioactive discharges of Paks Nuclear Power Plant up till 2003

REGULATORY RESTRICTION FOR LIQUID DISCHARGES [Bq/year] per unit	
Fission- and corrosion products (without tritium)	3.7×10^{9}
Tritium	7.5×10^{12}
^{90}Sr	3.7×10^{7}
Alpha-emitters	–

- The activity of radioactive materials discharged together with waters is not permitted to exceed the value of 0.4 GBq for one calendar day (for 4 units).
- Determination of the discharge shall be performed by gross beta measurement.
- In the sewage canal (collecting human excrement), after the sewage purification equipment, if it is possible the activity concentration shall be always below the value of 100 Bq/dm^3, or, in an extraordinary case, this concentration is permitted to be up to 1000 Bq/dm^3 for a maximum period of 30 minutes.
- Discharge from the monitoring reservoirs of waste water having an activity concentration of more than 1000 Bq/dm^3 is not permitted.
- The discharge of alpha-emitting isotopes originating from the nuclear power plant is not permitted; their discharge shall be monitored on the basis of a gross alpha measurement, under a detecting limit of 0.011 Bq/dm^3.

An8.1.2.b 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 discharge- and environment monitoring system designed in the 70's has become obsolete from both technical and ethical aspect, moreover the execution of this reconstruction was also required by a regulatory decision. Its full completion is expected around the middle of 2005.

One of the tasks of the operational discharge- and environment monitoring system in the nuclear power plant is to confirm, by means of continuous monitoring of the discharges, the fulfilment of the discharge limit values. The quick mapping of the radiation condition of the environment is indispensable also for judging the environmental consequences of an eventual incident, as well as for decision making on possible interventions affecting the population.

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 in a central computer and archived.

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:	$1 - 10^6$ Bq/m^3
	gross α:	$10^{-2} - 10^4$ Bq/m^3
Noble gas	gross β:	$10^2 - 4 \times 10^9$ Bq/m^3
Radioiodine	γ:	$1 - 1 \times 10^6$ Bq/m^3

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 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 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 very extensive environmental radiological monitoring system has been established in the surroundings of the nuclear power plant.

Measuring and sampling capabilities of the various stations:

1. A-type station:
   - gamma-radiation dosage rate (on-line) and dosage measurements executed by TLD,
   - 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. B-type (reference) station:
   - dose measurements executed by TLD,
   - aerosol and iodine sampling,
   - air sampling for determining tritium and radio-carbon,
   - fall-out,
   - soil and grass sampling.
3. C-type station:
   - dose measurements executed by TLD,
   - if needed, collection of soil, grass and fall-out sample.
4. G-type station:
   - gamma-radiation dose rate (on-line).

Intervention levels

The radiological leader of the Emergency Preparedness Organization, on the basis of values specified in the following section, 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 leader of the Emergency Preparedness Organization, it is possible to order the application of a given protective measure also at values lower than ones specified in the following:

- Isolation: 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
- 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

An8.1.2.c Discharge data for the years 2003-2004

The discharge data of 2003-2004 are included in Table An8.1.2.c-1. with the following notes:

- The data concerning the year 2003 include discharges originating from the April 2003 incident that occurred during the cleaning of assemblies at Unit 2.
- The regulatory restriction of discharges changed in 2004. Consequently the discharge limit value criterion is included instead of the index for utilization of the regulatory limit.
- As of the year 2004, an isotope-selective determination of discharges has been performed per chemical form, while during the previous years the corrosion and fission products, as well as the noble gases had to be determined by measuring the gross beta radiation.

Table An8.1.2.c-1 Discharge data of Paks Nuclear Power Plant for the years 2003-2004

Isotope groups	Total discharge for the year 2003 [Bq]	Utilization of the regulatory limit [%]	Total discharge for the year 2004 [Bq]	Discharge limit value criterion
Airborne discharges				
Corrosion and fission products	6.85×10^{9}	0.91	1.31×10^{9}	3.00×10^{-4}
Radioactive noble gases	5.19×10^{14}	4.01	3.35×10^{13}	5.05×10^{-4}
Radio-iodines	4.05×10^{11}	54.1	1.94×10^{8}	8.34×10^{-5}
^{89}Sr, ^{90}Sr	6.94×10^{6}	18.2	7.07×10^{4}	1.87×10^{-7}
Tritium	7.86×10^{12}	-	3.26×10^{12}	1.90×10^{-5}
Radio-carbon	6.80×10^{11}	-	6.92×10^{11}	2.83×10^{-4}
Total:	**-**	-	-	**1.19×10^{-3}**
Liquid discharges				
Corrosion and fission products	9.16×10^{8}	6.2	1.59×10^{9}	9.32×10^{-4}
^{90}Sr	9.46×10^{6}	6.4	2.93×10^{6}	1.58×10^{-6}
Tritium	1.64×10^{13}	54.6	1.60×10^{13}	5.52×10^{-4}
Alpha-emitters	-	-	2.65×10^{5}	3.69×10^{-7}
Total:	**-**	-		**1.48×10^{-3}**

An8.2 Budapest Research Reactor

An8.2.1 Management of the spent fuel assemblies

An8.2.1.a 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.

An8.2.1.b Systems managing spent fuel elements

The criticality of spent fuel of research reactors as well as of nuclear power plants is safely limited by the design of spent fuel storage facilities. The infinite multiplication factor of these facilities has to be 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 only for a limited number).

Heat production of the research reactor fuel elements is so low that the remanent heat is removed if stored in 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 internal transport of spent fuel the remanent heat does not cause a problem because of the limited time.

An8.2.2 Discharges

An8.2.2.a Regulatory framework

For radioactive discharges to air and water during the use of atomic energy the dose limit are given by Decree 15/2001 of the Minister of Environment and the following regulatory limits can be derived from it.

Discharge Limits to the Atmosphere

Applying a 50 μSv/year dose limit (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 limit (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

An8.2.2.b 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 (in case of damage of the can) discharged during isotope production; 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 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 month. 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 to enhance the decision on the necessary measures.

Water Discharge Paths

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 vessels.

The acid neutralizing shaft collects the water from the chemical laboratory of the reactor building and from the water preparation unit. No radioactive discharge can come from here, as neither washing of radioactive or contaminated objects, nor emptying of radioactive liquid is allowed. The detector located in the acid neutralizing shaft measures the activity of the water. The detector is part of the Radioprotection Measuring and Control System, the measurement is displayed in the control room, on the radioprotection board. 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 can be permitted only if the activity is below the limit.

The Budapest Research Reactor has two vessels, each 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. Discharge takes place if the free capacity in the vessels decreases to about 200 m^3 (discharge is usually every four to five years, depending on the activities performed). Before discharge the nuclide content and concentration are measured by means of gamma spectrometry. After this the water is cleaned by ion exchangers. The water from the ion exchangers has to be checked every day and the nuclide concentrations have to be determined. Discharge can only be done with the permission of the Environmental Control Group.

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. In case of 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; discharge to the environment is accomplished only here. The stack is used by the Isotope Institute Ltd. as well, 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 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.

An8.2.2.c Results of the measurements in 2004

Atmospheric discharge:
- noble gas (Ar-41 only): 55.6 TBq
- iodine: below the detection limit (<5 Bqh/m^3)
- aerosol: below the detection limit (3.7 Bq/m^3)

Discharge of liquid waste:
90 m^3 water, Cs-137: 24.5 MBq; Co-60: 28.4 MBq