REPUBLIC OF HUNGARY

NATIONAL REPORT

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

First Report, 2002

CONTENTS

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 29th September 1997, and ratified it on 2nd 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 seven 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 1960s. 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 1-7*. *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 performed at the request of Hungary. *Annex 7* deals with the remediation of the area of the closed uranium mine.

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This report describes conditions and data as of 31st December 2002.

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, May 2003

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 1960s. 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 1st 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 1st 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 2nd 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.

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.

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

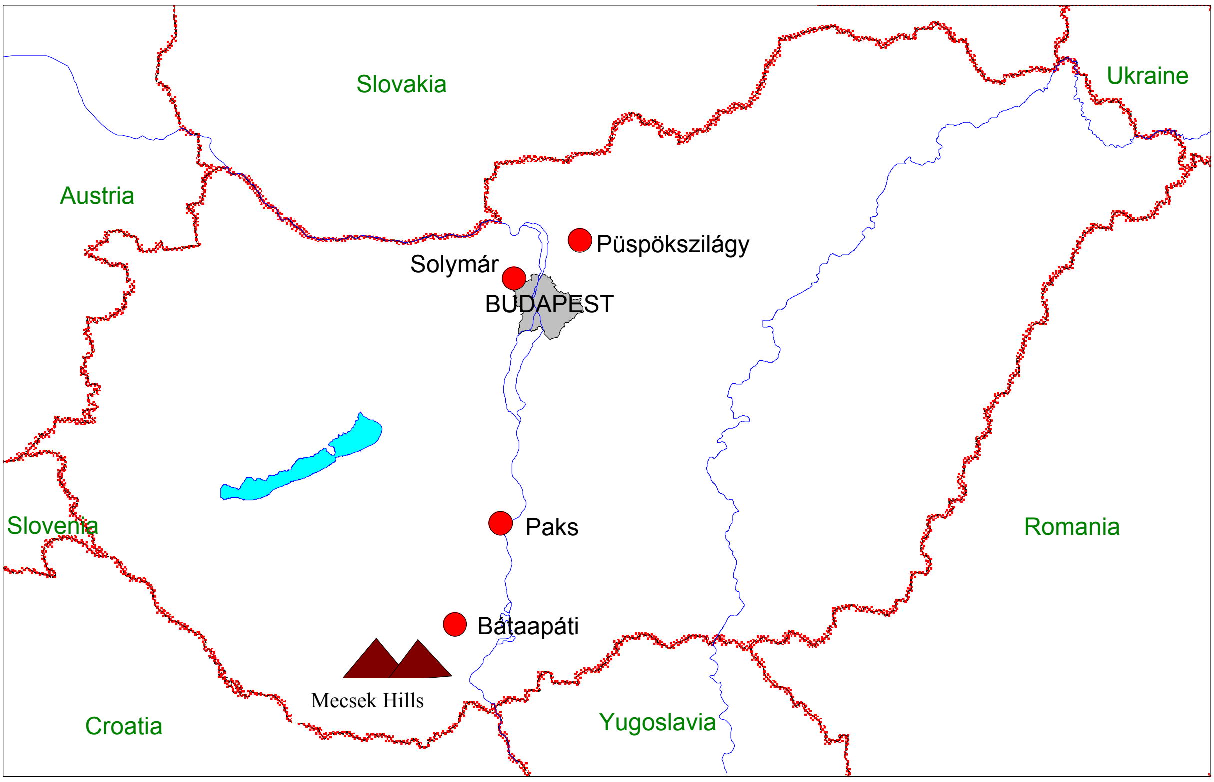

Figure B-1. Sites of importance in Hungary

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. The management of spent fuel in these facilities does not fall within the scope of this Convention.

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 inevitability of the closure of the mine planned for 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. Based on the results of the final report a recommendation was made for constructing an underground research laboratory for further research and to assess the suitability of the Boda Claystone Formation.

Later that year a decision was made on the closure of the uranium mine, which led to the loss of the underground laboratory. In view of this, a new basis for further investigations had to be found; this eventually led to the elaboration of a document entitled "Determination and evaluation of handling strategies for spent fuel and HLW, establishing a working programme and time schedule". This took place in 2001. Its implementation, i.e. the forming of the strategy, is one of the tasks to be faced in the coming years. The preparation of the programme starts in 2003.

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, 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 1990s, 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 construction, licensing and operation of an interim spent fuel storage was classified as a top priority, in 1993. The nuclear power plant commissioned the British company GEC Alsthom to build a dry storage facility of the MVDS type. One of the advantages of this type of construction and storage technology is that the number of storage vaults 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 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.

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 1980s, 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.

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 had 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*.

The facility was operated up to 1998 by the Capital Institute of the State Public Health and Medical Officer's Service of the Ministry of Public Welfare. Since 1st July 1998 the operation of the facility has been transferred to the new Public Agency for Radioactive Waste Management.

Initially, it was an obvious idea to consider the Radioactive Waste Treatment and Disposal Facility at Püspökszilágy as the best means of accommodating the wastes generated as a result of the operation and decommissioning of Paks Nuclear Power Plant. However, based on the geological investigations into the possibility of the near-surface solution, the expansion of the site to meet the needs of Paks Nuclear Power Plant turned out to be unfeasible.

Consequently, the low-level solid radioactive wastes from Paks Nuclear Power Plant were transported to Püspökszilágy only as a temporary solution. From 1990 to 1991 transportation of the wastes from the nuclear power plant to the repository was suspended because of public opposition. At the same time, in order to replace the volume occupied by the NPP waste, the disposal capacity of the Radioactive Waste Treatment and Disposal Facility was expanded with the financial support of Paks Nuclear Power Plant. Expansion gave the facility a disposal capacity of 5030 m^3. During the licensing procedure of the new part, 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. Up to now the temporary licence has been renewed five times (the last operational license is due to expire on 31st December 2004).

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 2002 the free capacity of the repository had decreased to 70 m^3.

Efforts over the past two years in relation to the Radioactive Waste Treatment and Disposal Facility, based on the investigations carried out so far, were mainly oriented towards demonstrating the safe operation of the facility and towards determining the measures necessary for its future closure. To this end, reconstruction and upgrading have been carried out, and safety assessments have been made.

New repository

Since 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, in early 1993, after some previous unsuccessful attempts, a national programme was launched with the aim at finding a solution for the final disposal of LLW/ILW of the plant. As part of the project, preparations for selecting a site have been started. Literature data have enabled the whole country to be 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 safety and economic studies, a proposal was made to carry out further explorations in the vicinity of Bátaapáti (Üveghuta) for a geological disposal site in granite. Another option, that of building a 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 assessments 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. A new consortium, BÁTATOM Ltd, was established with the view of implementing the programme by co-ordinating the most experienced organisations in Hungary (ETV-Erőterv Co., Mecsekérc Environment Protection Co., Golder Associates Hungary Ltd). The Geological Institute of Hungary acts as subcontractor. 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

In that the Radioactive Waste Treatment and Disposal Facility has only a temporary operating licence, the upgrading of this facility that has been in progress since 1998 and the safety analysis that will serve as basis to obtain the permanent operational licence are of outstanding importance.

Once a long-term or final operational licence has been issued for the Radioactive Waste Treatment and Disposal Facility, the possibilities for gaining free disposal capacity within the storage vaults will be investigated. This could provide a long-term solution for disposal of the 10-20 m^3/year radioactive wastes 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) should also 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, a detailed characterisation of the potential Bátaapáti (Üveghuta) site as well as the technical design of the repository is in progress.

Given that Hungary joins the European Union in 2004, it will thenceforth be obliged to undertake to fulfil the requirements and deadlines now being elaborated by the European Union.

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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 2nd 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.

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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.

As of 31st December 2002, a total of 2170 fuel assemblies were in the spent fuel ponds in the nuclear power plant, and 3017 fuel assemblies were stored in the Interim Spent Fuel Storage Facility.

By the end of 2002 the total capacity of the Interim Spent Fuel Storage Facility was 4950 in 11 vaults. Future expansion of the facility could increase the capacity to 33 vaults.

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. 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, 807 fuel assemblies are stored on the site with 75 kg heavy metal content. The reactor is scheduled to operate until 2023, thus from now to the end of its operational life, 1830 “single” spent assemblies should be taken into account. If 50% burn up is assumed, this means 252 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. At present the storage facilities of the KFKI Atomic Energy Research Institute have a capacity for spent fuel totalling 585.9 kg heavy metal content.

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. 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 would be 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

Classification of radioactive waste, in accordance with the Hungarian Standard MSZ 14344/1-1989, is given in Tables D.2.1-1 and D.2.1-2 below.

Hungary's waste categorisation system is based on activity concentration. The three categories are low level waste, intermediate level waste and high level waste - depending on the activity concentration or the surface dose rate of the radioactive waste.

Table D.2.1-1 Classification of radioactive waste

Category of radioactive waste	Activity concentration [kBq/kg]	Dose rate in air [μGy/h]
Low Level (LLW)	less than $5x10^5$	less than 300
Intermediate Level (ILW)	$5x10^5$ - $5x10^8$	300 - 10^4
High Level (HLW)	above $5x10^8$	above 10^4

Note: For waste containing trans-uranic elements, a specific classification is applied.

Table D.2.1-2 Classification according to decay

Waste type	Half-life
Short lived	less than 30 days
Intermediate	30 days - 30 years
Long lived	above 30 years

The rules 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 2002, about 60 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 wastes is 2.5 m^3/year; the amount that will be generated by the end of the planned life-time will be less than 100 m^3.

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 10-20 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 1430 m^3 by the end of 2002. Between 1983 and 1996 the nuclear power plant shipped low level solid waste to the facility. Altogether 1580 m^3 waste was disposed of, occupying 2500 m^3 of the repository.

By the end of 2002, according to the currently available best estimate, the total activity of the radioactive waste disposed of in the repository was 1060 TBq, based on data still to be verified (see *Section K*).

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 ^{92}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; 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.

Solid wastes are classified from the point of view of potential processing into compactible and non-compactible categories. The amount of solid waste produced annually after compaction is approximately six hundred 200-litre drums, corresponding to 120 m^3 net waste, requiring a gross storage capacity of 210 m^3. On average, half of the amount of the solid radioactive waste is composed of plastic material, but it also contains metal, textile, heat insulation materials, rubber, wood, construction rubble, and paper.

At the end of 2002 the solid waste stored in the nuclear power plant occupied 1457 m^3, that is 74.5% of the available storage capacity. The amount of waste shipped to the Radioactive Waste Treatment and Disposal Facility as mentioned in the previous point has to be taken into account beyond this quantity.

The rate of generation of liquid radioactive waste (after evaporation) is 250 m^3/year for the four reactor units. Liquid radioactive waste is stored in specially designed tanks, the exhausted capacity of which is 91%. Taking into account the rate of generation and the available capacity, the tanks will be full within approximately 2-3 years. In small quantities other liquid wastes are also produced in the nuclear power plant. From the viewpoint of disposal, special mention is made regarding the ion exchange resins, whose rate of generation is 2.5 m^3/year. At the end of 2002, there was 5100 m^3 liquid waste in the nuclear power plant.

The technological equipment for further decreasing the amount of liquid waste has not yet been completed, but commissioning is in progress. The waste streams are not homogeneous and present a mix of many different radionuclides with a wide range of half-lives and activity (see *Annex 3*).

The quantities of different waste forms can be estimated on the basis of a 30-year operating life-time. The total volume of compacted and non-compacted waste for disposal will be approximately 2500 m^3 (12 500 drums) which means that a disposal capacity of about 4400 m^3 will be needed.

The volume of the evaporator concentrates for disposal is expected to be 3700 m^3, and of the used ion-exchange resins 320 m^3. It is foreseen that the estimated volume of the cemented evaporator concentrates is about 9250 drums (400 litre each) and about 1500 drums (200 litre each) of cemented ion-exchanger resins. Altogether, the requirement is a disposal capacity of about 7000 m^3.

D.2.5 Wastes 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. The total decommissioning LLW/ILW as conditioned will amount to some 20 000 m^3. The volume of HLW is estimated to be 3700 m^3.

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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 1st 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 issue 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 appoint - 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 the decommissioning of nuclear installations.

The control and supervision of the safe use of nuclear energy is the task of the Government. The Government fulfils its tasks through the Hungarian Atomic Energy Commission, the Hungarian Atomic Energy Authority, and the responsible ministers.

In matters related to peaceful uses of atomic energy the Hungarian Atomic Energy Commission is responsible for the preparation of decisions, co-ordination, and - in specified matters - decision-making. The Hungarian Atomic Energy Commission is made up of executive officers of the ministries and of certain of the central administrative bodies. The president of the Commission (who at the same time supervises the Hungarian Atomic Energy

Authority on behalf of the Government) is appointed by the Prime Minister from among the members of the Government. The president of the Hungarian Atomic Energy Commission performs the activities related to this position independently of his responsibilities as a minister.

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 State Public Health and Medical Officer's Service).

As far as radiation protection is concerned, the Act on Atomic Energy allocates regulatory tasks to several ministries. The regulation of radiation protection belongs to the Ministry of Health, Social and Family Affairs. The technical side of radiation protection in nuclear facilities and spent fuel management belongs under the regulatory authority of the Hungarian Atomic Energy Authority. The limitation of releases and thus protection of the environment belongs to the Ministry of Environment and Water, while 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 level practically possible. 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 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 calls also for hearings of citizens in local and neighbouring municipalities and of other interested groups. These issues are within the competence of the regional environmental protection inspectorates under the Ministry of Environment and Water.

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

E.1.1 Spent fuel management

Most of the issues related to the nuclear safety of spent fuel management are 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 entitle 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 - cover issues related to the nuclear power plant; two guides deal with research reactors.

At present, spent fuel storage facilities are licensed and supervised taking the rules of nuclear power plants as an analogy. The drafting of a sixth safety code covering all nuclear safety related issues of spent fuel storage facilities is in the final stage.

E.1.2 Radioactive waste management

The Act on Atomic Energy authorises the Minister of Health, Social and Family Affairs to determine in a decree the dose limits for employees engaged in the field of atomic energy applications and those 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.

This Decree stipulates that occupational exposures to workers shall not be higher than 100 mSv effective dose limit during 5 subsequent calendar years, and the effective dose shall not be higher than 50 mSv in any single year. It stipulates also, among others, the dose limits to the members of the population. The sum of external and internal radiation exposure from artificial sources shall not be higher than 1 mSv/year not taking into account medical (diagnostic and therapeutic) applications. In special circumstances and for a single year the authority may authorise an effective dose higher than this, provided that the average radiation exposure to the individual does not exceed the annual effective dose of 1 mSv during the period of five subsequent years starting from the year specified.

The radiation protection requirements of the final disposal of radioactive waste are set down in Annex 11 of Ministerial Decree 7/1988. (VII. 20.) issued by the Minister of Social Affairs and Health. This Decree was replaced by Ministerial Decree 16/2000. (VI. 8.) referred to above, but this part of it remains in force until the new regulation on radioactive waste management, now in preparation, enters into force. Ministerial Decree 7/1988. (VII. 20.) 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 neighbourhood of the facility should not be exposed to a yearly effective dose equivalent above 0.25 mSv.
- 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.

Consequently, the current dose constraint for the representative member of the critical group of the population is 250 μSv/year. The detailed regulation of radioactive waste management that is currently being drafted reduces this to 100 μSv/year and proposes a collective risk constraint of 10^{-5}/year for individual events involving damage to the repository.

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 matrix table of facilities in relation to geological aspects with the proposed rankings for evaluating the geological characteristics. Three other annexes respectively prescribe the special geological requirements for the siting of an underground disposal facility for high-level radioactive waste; an underground disposal facility for low- and intermediate-level radioactive waste; a surface and near-surface disposal facility for low- and intermediate-level radioactive waste. The Decree states that the geological suitability has to be certified in a final report and the overall suitability of the site must be proved in a safety assessment in which geological data are important input parameters.

E.2 Regulatory body

E.2.1 The Hungarian Atomic Energy Authority

According to the Act on Atomic Energy, the relevant authority regarding spent fuel management facilities is the Hungarian Atomic Energy Authority.

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 frame of which the issues of the building authorisation and supervision of safety related buildings/structures are also covered.

The activities of the Hungarian Atomic Energy Authority 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 have been carried out. The structure of the Authority as presented in the organisational chart (Fig. E.2.1-1) was also influenced by the introduction of a quality management system (based on international standard ISO 9001:2000) in 2002.

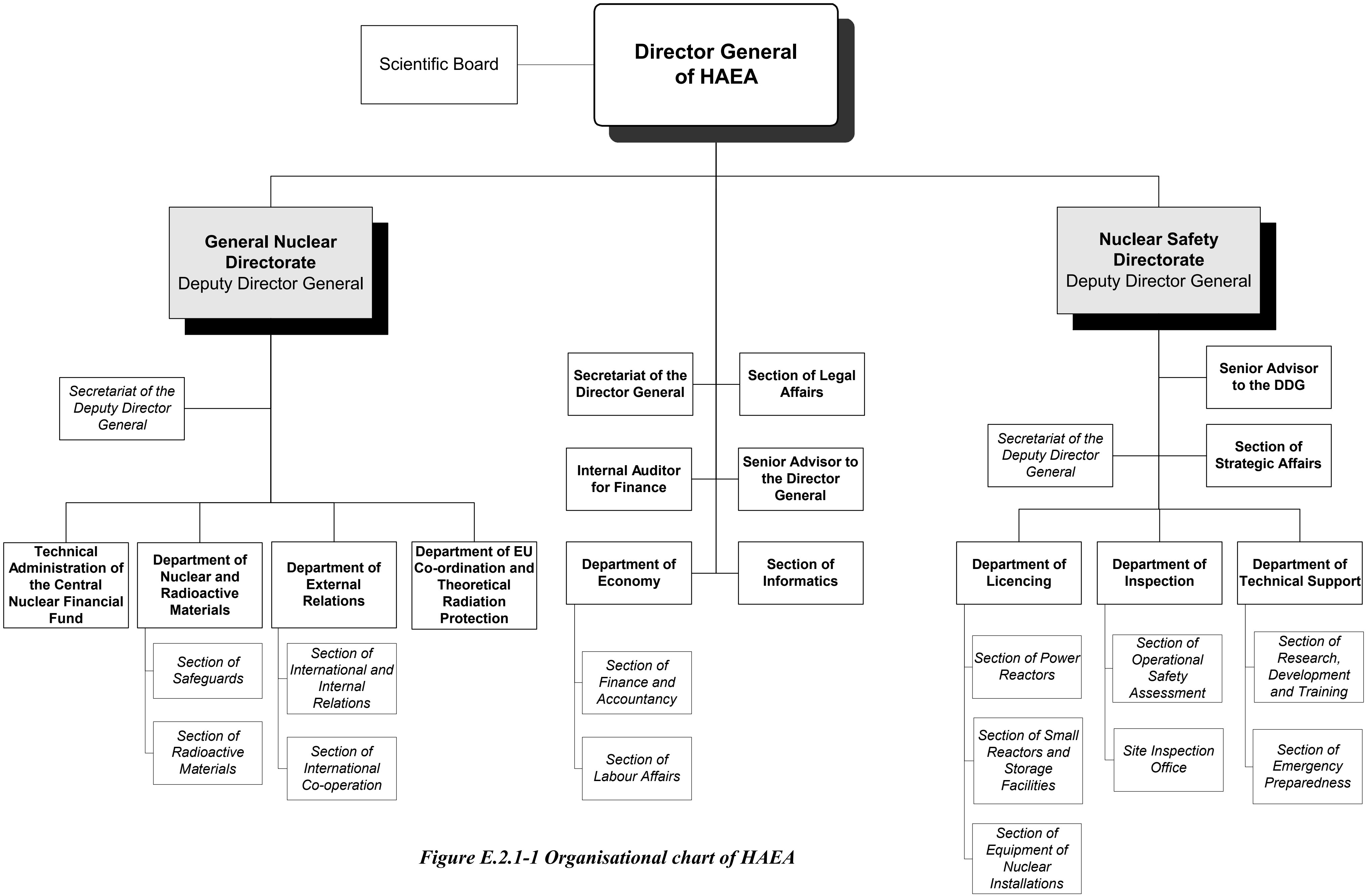

Figure E.2.1-1 Organisational chart of HAEA

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 Radiochemistry of 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 State Public Health and Medical Officer's 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 bodies of the State Public Health and Medical Officer's Service. This applies to spent fuel management facilities as well.

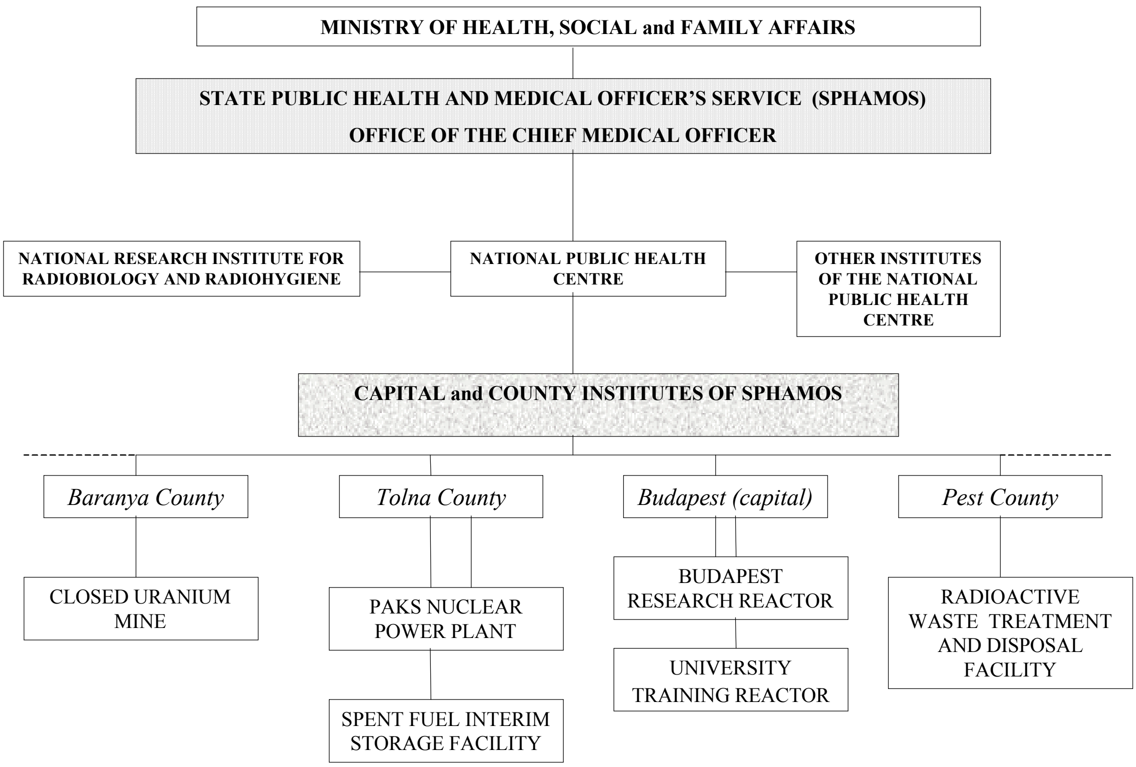

Figure E.2.2-1 Structure of the radiological health authority and centres in Hungary

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 specialised expert authority of radiation protection questions having the right of consent. The institute of the Fodor József National Public Health Centre of the State Public Health and Medical Officer's Service, the National "Frédéric Joliot-Curie" 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 county level bodies of the State Public Health and Medical Officer's Service are empowered to supervise (including inspections) the adherence to radiation protection rules and prescriptions in spent fuel management activities, as well as in all other civilian uses of atomic energy.

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, Social and Family Affairs, through the State Public Health and Medical Officer's Service, with expert advice and technical assistance provided by the National "Frédéric Joliot-Curie" 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 other relevant public administration organisations participate as so-called special authorities. These special authorities are designated by legal regulations. Through these authorities

- the Minister of the Interior enforces aspects relating to public and domestic order, fire protection, security and civil defence;
- the Minister of Agriculture and Rural Development enforces aspects relating to food, plant- and animal hygiene, as well as soil protection;
- the Minister of Economy and Transport (through the Hungarian Geological Survey) enforces aspects relating to geology;
- the Minister of Environment and Water enforces aspects relating to environment protection, nature conservation, water utilisation and protection of water bases, and protection of water quality;
- the Minister of Economy and Transport, enforces aspects relating to traffic, and to transport;
- the building authority competent for the area enforces aspects relating to regional planning and building;
- the President of 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 only be deployed in the way defined by law, and with regular inspection and assessments by the authorities. The licensing authority is liable to check compliance with all legal stipulations, and the safety of the applications of nuclear energy.

The authority is entitled to perform inspections both with advance notice, or without notice should the latter be considered justified. Inspections may be performed periodically in order to continuously assess safety; they may be based on a comprehensive predefined programme, or they may be specifically related to a particular event or activity. Inspection performed by the authority is defined as the observation of an activity carried out on site, the inspection of any documentation, or the checking of a report prepared by the licensee, or any combination of these. With regard to comprehensive and periodic inspections, the authority prepares a programme and notifies those involved in due time. 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 - has 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 of the State Public Health and Medical Officer's 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 (Pest County Institute of the State Public Health and Medical Officer's Service, with expert advice and technical assistance provided by the National "Frédéric Joliot-Curie" 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 87/1997. (V. 28.) (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 written procedure introduced in 2002. This procedure published in an internal document of the Hungarian Atomic Energy Authority 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 by means of sanctions, if necessary.

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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, 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 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 three basic principles of radiation protection;
- to maintain (regulatory and/or its own) dosimetry control;
- to derive from the dose constraint specified by the radiation protection authority and submit the estimated annual discharge limits 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 violent intrusions;
- supply data related to the information and alarm of the population in cases when the emission limits are exceeded and assurance of the conditions thereof;
- supply data on the quantity and composition of the material emitted in the case of a severe 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 a staff of 93 members, 76 of whom hold a higher education degree (university or college), 43% of whom have two degrees (the second degree usually being in the area of nuclear techniques). Fourteen people have scientific degrees, and 53 have passed state examinations of 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 from the nuclear installations, and its funding is sufficient to carry out its duties efficiently.

F.2.1.2 The State Public Health and Medical Officer's Service

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

The State Public Health and Medical Officer's Service, as the competent authority, is independent from the sphere of the licensees. In 7 county (including the capital) institutes about 80 qualified persons are employed in the field of radiation protection. These institutes have radiation measuring instruments and a well-equipped radiation laboratory. In special cases, the tasks for the authority undertaken by institutes of the State Public Health and Medical Officer's Service are supported by the National "Frédéric Joliot-Curie" Research Institute for Radiobiology and Radiohygiene (with about 160 highly qualified employees).

The State Public Health and Medical Officer's 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. Governmental Decree 240/1997. (XII. 18.) authorised the Director General of the Hungarian Atomic Energy Authority to establish this organisation, 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. 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, the Radioactive Waste Treatment and Disposal Facility;
- public information and relations.

The central offices of the agency are in Budaörs, close to Budapest. The management and administrative activities within each directorate are performed in Paks, on the site of the Interim Spent Fuel Store Facility. The Radioactive Waste Treatment and Disposal Facility is situated in Püspökszilágy. Altogether 80 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, 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 (up to the decommissioning of the nuclear facilities), a medium-term plan (for five years), and an annual work schedule are to be prepared on the use of the Fund. The preparation of these plans/schedules is one of the responsibilities of the Public Agency for Radioactive Waste Management. The long- and medium-term plans are to be annually reviewed 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 liabilities of Paks Nuclear Power Plant for annual payments into the Fund 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. The payments by Paks Nuclear Power Plant should be taken into account when determining the price of electric energy.

The institutes disposing radioactive waste in the Radioactive Waste Treatment and Disposal Facility are also liable to contribute to the Fund according to a 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 a way 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.

Table F.2.2.2-1 shows the development of the financial status of the Fund from 1998 to 2002.

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
Payment by Paks NPP	7428.7	9164.9	9311.3	14 877.1	17 199.3
Payment by other organisations	3.6	6.2	5.6	9.8	6.5
Contribution from the central budget (maintaining value)	-	227.9	1132.1	0	0
Expenditure from the Fund	3941.1	3630.9	2094.1	6084.0	11 239.4
Accumulation in the Fund	3832.7[2]	5768.1	8354.9	8802.9	5966.4

Notes: [1] exchange rate in December 2002: 1 Euro = 233 HUF
[2] because of a tax refund there was additional income in this year

By the end of the year 2002, the total sum accumulated in the Fund was M HUF 32 725.

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 108/1997. (VI. 25.) 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 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 tasks for the authority, including measurements, of the State Public Health and Medical Officer's Service are also carried out under a quality assurance programme. The majority of the laboratories have been accredited, the remaining laboratories are in the process of accreditation.

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. According to the decree, the licensees of nuclear facilities and radioactive waste repositories have to derive the annual release limits from the dose constraint specified by the Chief Medical Officer's Office. For example, the dose constraint for Paks Nuclear Power Plant is 90 μSv/year, for the Interim Spent Fuel Storage Facility 10 μSv/year, for the Radioactive Waste Treatment and Storage Facility 100 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 regional environmental authority, the Inspectorate for Environment Protection. 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 10% of the release limits with the exception of tritium from the releases of Paks Nuclear Power Plant; this amount is about 50-80% of the limit.

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. On the basis of this act a new integrated, in certain aspects unified, system for protection against all kinds of catastrophes was introduced, and the earlier laws and organisational structures were amended. The new regulation makes use of the experience gained earlier but also considers the obligations generated by international and bilateral agreements, treaties, recommendations of international organisations, and the regulations of the European Union.

The protection system against catastrophes in emergency 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 the person 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.

In the case of a nuclear accident it is the task of the specific National Defence Committee to give expert opinion and advice to the decision-makers. A given National Defence Committee is set up on the decision of the Ministry of Interior, its head is appointed by the state secretary of the Ministry of Interior, members are appointed by the heads of the corresponding ministries and bodies of national competence. The Hungarian Atomic Energy Authority operates an Expert Section within the relevant National Defence Committee.

The deployment of intervention forces, if necessary, is to be recommended by the head of the Operative Staff. The Operative Staff consists of the delegates of the Directorate General for National Emergency Management of the Ministry of Interior and the corresponding ministries. The Minister of Interior appoints the head of the Operative Staff.

Members of the nuclear emergency section of the Scientific Council of the Governmental Co-ordination Committee are appointed by the Director General of the Hungarian Atomic Energy Authority. The main duty of the Scientific Council is to give technical and scientific aid mainly in the course of preparation for emergencies to support the decision-making process and the decisions in order to enhance emergency preparedness and to handle the consequences of an emergency.

Furthermore, the system consists of sectorial organisations (e.g. in the field of healthcare, the police, etc.) and of regional- (county and capital) and local defence committees. These defence committees are not specified according to the types of emergency, but may differ depending on local circumstances (e.g. presence of a nuclear installation). The local defence committees are headed by the mayors of communities.

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, Social and Family Affairs.

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.

The comprehensive revision of the National Emergency Response Plan is close to its end. 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. It will introduce classification of facilities according to 5 planning categories and establish (a maximum of) 3 prevention zones around each. Paks Nuclear Power Plant (and 3 foreign nuclear power plants relatively close to the Hungarian border) are 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. (The long-term protective action planning zones of two nuclear power plants in the Slovak Republic and one in the Republic of Slovenia extend to the territory of Hungary and the same zone of Paks Nuclear Power Plant extends beyond the Hungarian border.)

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 by the Hungarian Atomic Energy Authority biannually.

The Emergency Response Plan of the Interim Spent Fuel Storage Facility includes the emergency response tasks of the staffs of the Public Agency for Radioactive Waste Management and Paks Nuclear Power Plant in any accident situation affecting the Interim Spent Fuel Storage Facility. These tasks shall be performed in co-operation with the competent authorities and organisations.

The accident prevention and emergency response activities are performed in accordance with the relevant operation and maintenance, and accident prevention procedures. The activities to be performed in relation to radiation safety and health physics, the monitoring of the operational staff, together with the dose exposure limits, are included in the Facility Radiation Protection Regulation of the Public Agency for Radioactive Waste Management.

The work of the emergency response organisation of the facility 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

An Emergency Response Plan is provided for managing any off-normal situations, operational disturbances, accident conditions, and breach of procedural requirements in the Radioactive Waste Treatment and Disposal Facility. This includes the description of events potentially occurring in the facility and the hazard categories to be adopted. The Plan also specifies the actions to be carried out by the site staff, the list of people to be notified, and the order of 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.

The members of the accident prevention units of different organisations, facilities and sectors receive regular training to handle their specific tasks. There may be alerting exercises; drills or part-task exercises; or full-scale exercises when tasks are accomplished by the entire emergency organisation of the facility, possibly in co-operation and with the partial involvement of regional or national level bodies.

Certain sectors organise part-task exercises independently of the whole national level system. In addition, the Emergency Response Plans prescribe the regular testing of the reliability of communication and public announcement systems. 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 is in preparation for the year 2004.

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.

Hungary is an active participant of the regional harmonisation project launched by the International Atomic Energy Agency that deals with the prevention and management of nuclear accidents. This project provided significant assistance during the revision of the National Emergency Response Plan.

The establishment of co-operative relations with the professional bodies of the European Union is an integral part of our accession process. As an initial step towards co-operation, negotiations are in progress concerning our joining ECURIE, the early notification system operated by the European Union.

Hungary has concluded bilateral agreements with the following countries in the areas of early notification, mutual provision of information and co-operation in nuclear emergency matters: Austria (1987); the Czech Republic and the Slovak Republic (1991); the Federal Republic of Germany (1991); Republic of Slovenia (1995); Romania (1997); Ukraine (1997), 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 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. 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 the nuclear power plant 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. In case of the research reactor, at the time of its complete reconstruction between 1989 and 1993 the Hungarian Atomic Energy Authority requested that a preliminary decommissioning plan be made, but the result was not comprehensive enough to meet present requirements. The preparation of a preliminary decommissioning plan as prescribed will be carried out as a compulsory part of the enhancement measures at the time of the forthcoming periodic safety reviews both for the research reactor and for the training reactor. 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.

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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

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 basis earthquake;
- 0.35 g for safe shutdown earthquake.

Re-evaluation of the seismic hazard of the site defined a maximum horizontal seismic acceleration value of 0.25 g at an earthquake recurrence frequency of one in 10 000 years; this value was approved 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 vaults (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. The outside cooling air and the storage gas within the storage tube cannot intercommunicate.

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 vaults, 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 performed 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.

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, within the United Kingdom Atomic Energy Authority, upon the commission of 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 real potential events.

Although the Interim Spent Fuel Storage Facility was designed expressly for the storing of 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 vaults 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 are satisfied at 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 31st 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 for loading 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 1-4 of the Nuclear Safety Code, issued as attachments to Governmental Decree 108/1997. (VI. 25.), 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, there have been only a few events (two events in 2000, one in 2001, and one in 2002) which were required to be reported to the authority. None of them reached Level-1 of the INES Scale.

The environmental licence of the Interim Spent Fuel Storage Facility was issued by the Lower Danube Valley Environmental Authority. 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 Paks office of the Public Agency for Radioactive Waste Management. This organisation is also responsible for the handling and maintenance of the documents.

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In conclusion, it can be stated that the practice followed by the Interim Spent Fuel Storage Facility complies with the obligations 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 providing long-term isolation. In accordance with the 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 enough time to elaborate the national policy and strategy.

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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 using 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.

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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 Safety of the Radioactive Waste Treatment and Disposal Facility

Assessment of safety and safety upgrading

Although the safety of the facility was carefully considered, it has not previously been 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 a temporary operational licence was issued - now valid till 31st December, 2004. The regulatory body requested that a comprehensive safety assessment be carried out as a precondition of granting the permanent licence.

In 2000 and 2001 two safety analyses were completed: one was performed by the Hungarian company ETV-Erőterv, the other one was carried out by the British company AEA Technology in a project funded under the European Commission's PHARE programme.

Safety assessments 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. The assessments were carried out with the following objectives:

- to provide a view on the performance of the facility that would support licensing decisions;
- to identify key issues that need to be addressed in future safety assessments;
- to direct the programme of site characterisation and research;
- to provide input concerning future developments and design improvements at the site;
- to build confidence among stakeholders.

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.

The approach to safety assessments involved the use of

- relatively detailed models for certain parts of the repository system, e.g. 2-D or 3-D models of saturated and unsaturated groundwater flow and transport in the vicinity of a repository;
- simplified assessment models, e.g. for probabilistic calculations;
- simple analytic and numerical models to demonstrate or communicate understanding of the behaviour of the repository system.

An important aim of the approach was to understand the key processes and their effects on safety and to identify the key parameters. To this end both deterministic and probabilistic models were used.

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 will be given to the remediation possibilities which could include

- 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. Such an optimisation process has never before been performed in Hungary. 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 are 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

The repository has been operated without any accident or significant release of radioactivity to the environment. However, no investments for upgrading have 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. The main areas of the upgrading activities that commenced in 2001 included the improvement of

- 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 raw low- and intermediate level radioactive waste from isotope applications, it remained unused. In the design, provision had been made for using the pit located in the basement of the building to sink special wells (boreholes) for the disposal of spent sealed radioactive sources. The centralised interim store can also serve as a 'buffer storage' especially in cases when an urgent need may arise for accommodating a comparatively large amount of waste at the repository site.

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 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 have been set out, alternative solutions had to be examined both in terms of location and the mode of disposal. Thus both near-surface and mined 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. In the surveys carried out between 1993 and 1995 covering the area of the whole country, about 300 geological formations were identified as being potentially suitable for either near-surface or underground disposal facilities. In the initial phase of site exploration, using exclusion criteria, all areas were ruled out that must be protected for political, economic, geological, etc. considerations or where the disposal site needs to be protected from industrial or natural influences. The next phase was 'positive' screening, in which geological prospects were evaluated from a suitability point of view, meaning the quality of the geological barrier. As a result, about 6000 km^2 out of the 93 000 km^2 area of Hungary were considered worthy of more research related to near-surface disposal, and about 23 000 km^2 related to subsurface disposal. A suitable site could be expected in areas where the number and density of potential prospects proved to be high. Using this approach, an area of 5000 km^2 was selected for further exploration. 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 the first 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 was $1x10^{-6}$/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.

Activity 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 hydraulic 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.

As some Hungarian experts have expressed reservations concerning the adequacy of the site investigations, in May 1999 the Hungarian Atomic Energy Authority requested the International Atomic Energy Agency to organise an international peer review of the research on site selection and site suitability for the candidate site for LLW/ILW disposal in Hungary. This was undertaken within the framework of the Agency's Waste Management Assessment and Technical Review Programme (WATRP). The main focus was a review of the screening process, including the associated regulatory framework, that led to the selection of the Bátaapáti (Üveghuta) area for siting a disposal facility for LLW/ILW, and of the scientific investigations that were conducted on the preferred site, to determine if they are in accordance with international requirements and guidance, and with good science and engineering practice.

The WATRP team 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. The Bátaapáti (Üveghuta) site appears potentially suitable for developing a safe repository for the disposal of low and intermediate level operational and decommissioning wastes from nuclear power generation. The site characterisation and repository design, however, should continue. The probability of any adverse effect on the safe performance of the planned repository due to seismicity is very low. Based on a meeting with local representatives, the team stated that an effective and open communication programme appears to have been established.

Simultaneously, the South Transdanubian Regional Bureau of the Hungarian Geological Survey also provided expert views on the work completed. They drew conclusions similar to those of the WATRP team.

Current activities

From early 2002 onwards, the research and exploration work has continued on the basis of these opinions and proposals. Based on the new geological exploration plan, supplementary on-site investigations have been pursued. There is a need for integrated safety assessment using the currently available site- and conceptual design information that should also include a broader spectrum of scenarios. Such an integrated safety assessment should form the basis for continued site characterisation. For licensing purposes, further geological and engineering examinations 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 tunnel-type arrangement seems favourable. Both the waste drums and the disposal containers would be placed in the disposal areas 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. Granite pillars of 10-20 m thickness would separate 6 or 10 m wide disposal galleries ensuring the mechanical stability of the repository. Design of the layout and of the characteristics of the disposal areas will need to be refined after further geological investigations.

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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 32/2002. (III. 1.) on the licensing of shipments of radioactive waste across the national border. The Decree is in concordance with Council Directive 92/3/Euratom 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 State Public Health and Medical Officer's Service and the Headquarters of the Police.

The decree prohibits shipments from Hungary to a destination south of latitude 60° south and to any state being a party 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.

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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 of the Chemical Research Centre of the Hungarian Academy of Sciences on behalf of the Hungarian Atomic Energy Authority, and their full life-time is followed up. This is regulated in detail in Decree 25/1997. (VI. 18.) of the Minister of Industry, Trade and Tourism on the registration of radioactive materials and preparations. Legislation requires that unused radioactive sources be disposed of. 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. The legislative system does not prevent Hungarian manufacturers from fulfilling such obligations. In recent practice, numerous such obligations have been undertaken, however, no actual re-shipments have taken place so far.

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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 1990s, thus the facility is considered to be up to date. In view of this, safety enhancement measures affecting the operation of the substantial systems are not required. Some minor modifications have been carried out on the Fuel Handling Machine (introduction of a newly designed power supply system, software modification, and travel resolver modification), on the waste-water discharge system, and on the cask transfer trolley. However, it is emphasised that these modifications had no impact on the essential safety parameters of the storage facility.

The construction of four more new vaults (vaults Nos. 8-11) of the Interim Spent Fuel Storage Facility was completed by the end of 2002. 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 vaults constructed so far. This in turn means that a new licensing procedure has to be initiated prior to commencing the construction of the extension becoming timely in 2006. In preparation for this work, an assessment was performed to examine whether further vaults should be added to this type of modular store or whether it is possible to find a new solution for extending the storage facility with the same level of safety, within the required deadline but with greater cost effectiveness. Subsequently, a decision was reached on the results of the assessment: it was decided that it is not practical to change to another storage method and the construction of further extensions to the present modular store facility is reasonable.

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-1990s 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.

The implementation of the safety measures is envisaged to start in 2004 and would last for several years depending upon the remediation measures selected. The project takes into consideration all relevant Hungarian regulations, EC Directives, IAEA Safety Series documents, recommendations, as well as other international recommendations regarding current best practice in this field.

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 cement, 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 (of type ‘B’ and ‘D’) 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. Besides the part being carried out by Hungary and the planned International Atomic Energy Agency support, the third ‘pillar’ of the technical co-operation in the safety enhancement programme is the European Union PHARE project. The aim of this PHARE project is to select the most appropriate and acceptable method of safety upgrading. The feasibility study in preparation provides a consistent scheme for analysing the problem and for ensuring that all factors essential for successful implementation are addressed.

Important advance work has already been performed in the context of two recent feasibility studies sponsored by the European Union in the following areas:

- the conversion of the treatment building into a long-term storage facility on the site;
- the assessment and characterisation of the possibilities of volume reduction of the recoverable low-level solid waste packages deposited in the repository.

ANNEX 1: THE INTERIM SPENT FUEL STORAGE FACILITY

An1.1 Description of the facility

The Interim Spent Fuel Storage Facility is a modular vault dry store 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 vault 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 or vaults serve for the storage of the spent fuel. These modules or vaults 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 vault 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 vault is covered by a structural steel building to form the charge hall.

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 vault by the thermosyphoning effect, thereby ensuring adequate cooling without the need for any active mechanical systems or human intervention.

An1.4 Guarding

The site of the Interim Spent Fuel Storage, as an independent safety zone functionally integrated into the safeguard system of Paks Nuclear Power Plant, has continuously operating security equipment and appropriately trained security guards. The system is designed to prevent uncontrolled access of persons and/or vehicles and to warn the security staff of any attempt to trespass. This is provided by independent perimeter fence guarding and camera monitoring systems. Vehicle access by road to the Interim Spent Fuel Storage Facility is possible only from the power plant site. The conditions specified for the entry of persons and vehicles to the site are more rigorous than those specified for the nuclear power plant.

An1.5 Radiation protection and environmental protection

Radiation 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.

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 2001 the amount of the discharges was only 0.002% of the derived limits.

Personal radiation monitoring is performed with the use of film dosimeters, as required by the authorities, supplemented with thermoluminescent detectors and electronic dosimeters.

Environmental protection

Since the sites of the Interim Spent Fuel Storage Facility and 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 in each year. This means that it has never exceeded 0.003 per cent of 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. 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.

An2.3 Transport, disposal and record keeping

The transport of radioactive waste to be disposed of or stored on the 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 1980s 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 site is guarded by well-equipped security guards. In 2002, a complex area surveying system was put into operation. A computer controlled video monitoring system monitors the site. The new protective fence system, giving automatic signals on any movement, completes the security of the site. The survey system is combined with an electronic card-based access control system, which registers all information concerning movement in and out of the site.

The access control system, as part of the refurbishment programme, was installed in 2001.

In 2001, access to the controlled area of the site was newly regulated. Two gateway monitors help to detect any unwanted contamination and illegal transport of radioactive materials. State-of-the-art equipment ensures the adequate radiation protection control of the site and its environment.

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 has been 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 observation well on site. A special investigation programme was set up to address the issue: the first results on the origin of the tritium and on the hydrogeological conditions will be available by 2004.

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 near-by pond is also part of the environmental monitoring programme. Radioactivity of flesh, bones and pluck of sheep and goats grazed 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 Pest County Institute of the State Public Health and Medical Officer's Service. During inspections, the authority supervises the site itself and does sampling in the vicinity of the site.

The environmental monitoring system was reconstructed in 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 the non nuclear power plant 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 31st December 2001. Short lived isotopes are not included. As referred to in *Section K*, further efforts are needed to specify the inventory.

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	2.8E+14	3.0E+12	2.9E+14
^{14}C	3.5E+12	7.4E+07	3.5E+12
^{60}Co	4.2E+13	3.2E+14	3.6E+14
^{85}Kr	1.4E+11	7.5E+09	1.5E+11
^{90}Sr	4.0E+13	4.7E+11	4.1E+13
^{99}Tc	9.6E+09	1.7E+05	9.6E+09
^{137}Cs	5.2E+12	2.8E+12	8.0E+12
^{210}Pb	5.0E+08	3.4E+07	5.3E+08
^{226}Ra	1.3E+11	2.0E+11	3.2E+11
^{232}Th	4.5E+10	0	4.5E+10
^{234}U	5.2E+09	0	5.2E+09
^{235}U	2.6E+08	0	2.6E+08
^{238}U	3.5E+08	0	3.5E+08
^{238}Pu	5.1E+11	6.4E+09	5.2E+11
^{239}Pu	1.3E+10	1.2E+07	1.3E+10
^{241}Am	4.5E+12	2.9E+12	7.3E+12

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.

Table An3.2-1 Average and highest activity concentrations of radioisotopes in the wastes of Paks NPP (Bq/l)

Waste stream	Solid		Concentrate		Resin	
Isotope	**max**	**mean**	**max**	**mean**	**max**	**mean**
^{124}Sb	5.7E+05	5.2E+03	5.0E+04	9.6E+03	NA	NA
^{58}Co	3.6E+06	1.1E+05	3.7E+07	6.7E+05	6.4E+06	2.4E+06
^{110m}Ag	1.9E+06	8.7E+04	7.1E+06	2.3E+05	5.4E+08	9.8E+07
^{54}Mn	3.2E+06	1.1E+05	1.1E+07	2.3E+05	3.9E+08	10.0E+07
^{134}Cs	2.2E+05	2.9E+03	3.0E+06	2.3E+05	1.3E+08	1.9E+07
^{55}Fe	7.8E+07	2.5E+06	6.0E+05	2.4E+05	8.6E+09	3.2E+09
^{60}Co	1.1E+07	3.0E+05	2.5E+07	5.0E+05	6.3E+07	1.7E+07
^{3}H	NA	NA	3.9E+05	1.7E+05	5.3E+05	1.2E+05
^{244}Cm	1.2E-01	2.0E-02	4.7E+00	2.3E-01	8.8E+01	1.8E+01
^{90}Sr	9.6E+00	1.9E+00	4.2E+03	4.8E+02	1.7E+07	3.6E+06
^{137}Cs	2.3E+05	4.6E+03	7.1E+06	7.6E+05	2.2E+08	4.0E+07
^{238}Pu	2.8E-01	4.2E-02	1.8E+01	6.4E-01	3.6E+02	7.8E+01
^{63}Ni	2.2E+05	1.6E+04	2.5E+05	8.6E+04	1.2E+07	2.5E+06
^{241}Am	8.9E-01	9.6E-02	6.5E+00	4.4E-01	4.9E+02	8.6E+01
^{14}C	2.8E+05	1.5E+04	1.7E+04	5.6E+03	1.1E+07	4.3E+06
^{243}Am	NA	NA	3.0E-01	4.6E-02	6.6E-01	6.6E-01
^{94}Nb	5.8E+04	1.7E+02	3.9E+01	1.6E+01	1.4E+02	1.4E+02
$^{239+240}$Pu	3.9E-01	5.5E-02	1.7E+01	6.9E-01	7.0E+02	1.2E+02
^{59}Ni	2.2E+03	1.7E+02	1.5E+04	4.9E+03	2.4E+06	4.5E+05
^{41}Ca	1.1E+01	5.5E-02	4.5E+01	1.0E+01	6.1E+04	1.7E+04
^{99}Tc	5.6E+00	1.0E+00	2.2E+01	6.6E+00	1.0E+03	5.0E+02
^{234}U	1.2E-02	3.8E-03	9.5E-01	1.9E-01	2.1E+02	7.8E+01
^{36}Cl	2.9E-01	2.1E-02	6.8E+00	2.3E+00	1.7E+03	6.9E+02
^{135}Cs	1.2E+00	2.4E-02	3.7E+01	3.9E+00	1.1E+03	2.1E+02
^{129}I	3.0E-02	1.1E-03	5.4E-01	9.7E-02	7.0E+01	2.6E+01
^{235}U	2.5E-03	8.4E-04	8.9E-01	6.8E-02	8.5E+01	2.6E+01
^{238}U	9.2E-03	2.7E-03	1.2E+00	1.7E-01	1.8E+02	5.5E+01

Notes:
NA : no data available
Activity values are calculated for the time of the measurements (1992-2001)
The “mean values” are the mathematical average of the measured values
(20-100 measurements for each isotope).
The “max values” are the highest activity concentrations measured so far.

Table An3.2-2 contains the activity of certain radioisotopes, important for safety assessments, calculated on the basis of the average activity concentrations in the various waste streams and the estimated quantity of wastes for the end of the operational life-time of the nuclear power plant (2017).

As described in *Section D*, the amount of waste generated is assumed to be the following:

- solid waste 120 m^3/year
- concentrate 250 m^3/year
- resin 2.5 m^3/year

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 An3.2-2 Estimated activity of certain radioisotopes by the end of the operation of the Paks NPP (Bq)

Nuclide	Half-life [y]	Solid	Concentrate	Resin	Total
^{124}Sb	1.7E-1	6.6E+08	2.4E+09	NA	3.1E+09
^{58}Co	1.9E-1	1.4E+10	1.7E+11	3.7E+11	5.5E+11
^{110m}Ag	6.8E-1	1.6E+10	9.2E+10	1.5E+13	1.5E+13
^{54}Mn	8.6E-1	2.4E+10	1.0E+11	1.5E+13	1.6E+13
^{134}Cs	2.1E+0	1.2E+09	2.0E+11	3.1E+12	3.3E+12
^{55}Fe	2.7E+0	1.3E+12	2.7E+11	5.1E+14	5.2E+14
^{60}Co	5.3E+0	2.8E+11	10.0E+11	2.9E+12	4.1E+12
^{3}H	1.2E+1	NA	6.4E+11	2.3E+10	6.6E+11
^{244}Cm	1.8E+1	3.8E+04	1.1E+06	3.5E+06	4.6E+06
^{90}Sr	2.9E+1	1.0E+06	5.3E+08	5.7E+11	5.7E+11
^{137}Cs	3.0E+1	1.1E+10	4.2E+12	8.1E+12	1.2E+13
^{238}Pu	8.8E+1	1.2E+05	4.3E+06	1.7E+07	2.1E+07
^{63}Ni	1.0E+2	4.4E+10	5.8E+11	5.5E+11	1.2E+12
^{241}Am	4.3E+2	2.8E+05	3.2E+06	1.9E+07	2.3E+07
^{14}C	5.7E+3	4.5E+10	4.2E+10	9.6E+11	1.0E+12
^{243}Am	7.4E+3	NA	3.5E+05	1.5E+05	5.0E+05
^{94}Nb	2.0E+4	5.0E+08	1.2E+08	3.2E+07	6.5E+08

^{239}Pu+^{240}Pu	2.4E+4	1.6E+05	5.2E+06	2.6E+07	3.2E+07
^{59}Ni	7.5E+4	5.1E+08	3.7E+10	1E+11	1.4E+11
^{41}Ca	1E+5	1.6E+05	7.7E+07	3.9E+09	3.9E+09
^{99}Tc	2.1E+5	3.1E+06	4.9E+07	1.1E+08	1.6E+08
^{234}U	2.4E+5	1.1E+04	1.5E+06	1.8E+07	1.9E+07
^{36}Cl	3E+5	6.2E+04	1.7E+07	1.6E+08	1.7E+08
^{135}Cs	2.3E+6	7.2E+04	3E+07	4.6E+07	7.6E+07
^{129}I	1.6E+7	3.4E+03	7.3E+05	5.9E+06	6.7E+06
^{235}U	7E+8	2.5E+03	5.1E+05	5.8E+06	6.3E+06
^{238}U	4.5E+9	8E+03	1.3E+06	1.2E+07	1.4E+07
				Sum:	**5.7E+14**

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 12^{th} 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 6^{th} of March in 1972
Law-decree 8 of 1987	on the promulgation of the convention on physical protection of nuclear materials
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 20^{th} 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 10^{th} of September in 1996
Act XC of 1999	on the confirmation and promulgation of the Additional Protocol signed in Vienna on the 26^{th} 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 6^{th} 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 87/1997. (V. 28.)	on the duties and scope of authority of the Hungarian Atomic Energy Commission and on the scope of duty and authority, and jurisdiction of imposing penalties of the Hungarian Atomic Energy Authority

Governmental Decree 108/1997. (VI. 25.)	on the procedures of the Hungarian Atomic Energy Authority in nuclear safety regulatory matters
Annex No. 1: Nuclear Safety Code Volume 1	Authority procedures applied to nuclear power plants
Annex No. 2: Nuclear Safety Code Volume 2	Quality assurance code of nuclear power plants
Annex No. 3: Nuclear Safety Code Volume 3	General requirements for the design of nuclear power plants
Annex No. 4: Nuclear Safety Code Volume 4	Operational safety requirements of nuclear power plants
Annex No. 5: Nuclear Safety Code Volume 5	The nuclear safety code of research reactors
Governmental Decree 121/1997. (VII. 17.)	on the licensing of nuclear exports and imports
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 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 32/2002. (III. 1.)	on the licensing of shipments of radioactive waste across the national border
Governmental Decree 275/2002. (XII. 21.)	on the monitoring of radiation levels and radioactivity concentrations in Hungary

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 Health and Social Affairs 7/1988. (VII. 20.)	on the execution of the Enacting Clause of the Council of Ministers 12/1980. (V. 5.) to Act I of 1980 on Atomic Energy
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 No. 25/1997. (VI. 18.)	on the registration of radioactive materials and preparations
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

Decree of the Minister of Industry, Trade and Tourism 67/1997. (XII. 18.)	on the operation and administration of the Central Nuclear Financial Fund
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 charges of the subcontractors connected to the final disposal of radioactive wastes
Decree of the Minister of Health 16/2000. (VI. 8.)	on the execution of certain provisions of the Act CXVI of 1996 on Atomic Energy associated with radiation protection
Decree of the Minister of Environment Protection 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 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 30/2001. (X. 3.)	on the operational radiation protection of the outside workers

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 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 2001, like the previous reports, concluded that the nuclear applications in Hungary fulfil the relevant safety requirements. 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.

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 and 2001. The Reports were favourably taken up in the review meetings. The report of 2001 is 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

At the request of the Hungarian Government authorities, an International Atomic Energy Agency team of eight experts visited the Hungarian Atomic Energy Authority to conduct a mission. 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 review was conducted from 22nd May to 2nd June 2000. The mission had a positive opinion of the activities of the Authority, and offered suggestions and made recommendations for further development. 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 IRRT mission report. In the case of most recommendations and suggestions the improvements have been implemented, in some other cases their implementation is under way. Hungary has invited a follow-up IRRT mission from the International Atomic Energy Agency. This event is scheduled for February of 2003.

An6.2 WATRP mission on LLW/ILW repository site selection

In 1999 the Hungarian Atomic Energy Authority requested the International Atomic Energy Agency to organise a review team to evaluate the research done on site selection and to comment on the site suitability of the candidate site for low and intermediate level waste disposal in Hungary. The mission was organised within the framework of the Agency's Waste Management Assessment and Technical Review Programme (WATRP). The main purpose of the request involved a review of the screening process, including the associated regulatory framework, that led to the selection of the Bátaapáti (Üveghuta) area for siting a disposal facility for low and intermediate level waste, and of the scientific investigations that have been conducted on the preferred site, to determine whether they are in accordance with international requirements and guidelines, and with good science and engineering practice.

The review team received written documents, conducted exchange of information through discussions with the respective Hungarian experts, including those who expressed reservations regarding the site, and visited the Bátaapáti (Üveghuta) site. The team considered that:

- The process that led to the selection of the Bátaapáti (Üveghuta) site appeared reasonable and had appropriately considered both the geological aspects and public acceptance.
- The Bátaapáti (Üveghuta) site appeared to be potentially suitable to host a safe repository. The site characterisation and repository design, however, should continue.
- The probability of any adverse effect on the safe performance of the planned repository due to seismicity was found to be very low.
- Based on a meeting with local representatives, an effective and open communication programme appeared to have been established.

The team recommended that:

- The Hungarian licensing criteria, as reflected in the relevant ministerial decree, are very prescriptive, in particular concerning geological requirements, compared to international requirements and guides. The team suggested that greater flexibility should be provided that would emphasise a comprehensive assessment of safety based on a combination of engineered and natural barriers.
- Some clarification is needed of the design concept and the kinds of engineered barriers to be included in the design. Safety should be achieved through a combination of engineered and natural barriers.
- The safety assessments that were provided to the team were based on limited, early, geological investigations. There is a need for an integrated safety assessment using the currently available site and conceptual design information and including a broader spectrum of scenarios. The integrated safety assessment should form a basis for continued site characterisation, and preferably be prepared, at least in part, before presenting the case to Parliament.
- The safety assessments to date have focused on long-term performance. As the design concept matures, there is a need to consider potential radiation exposures of workers and the public, as well as conventional mine safety, during repository operation.

The findings and recommendations of the WATRP Mission were taken into consideration in the work on the siting of the proposed LLW/ILW repository (see *Section H*).

An6.3 Reviews conducted in the framework of the PHARE programme

- Nuclear Waste Management Schemes in PHARE Countries, Proposals and Recommendations for Future Detailed Work Projects, Regional Programme for Nuclear Safety Improvement; CASSIOPEE Report, 1993.

- Technical support in the selection of a disposal option and candidate site for LLW/ILW in Hungary; 4.09/94 (Belgatom/IVO).

- QA and QC Procedures for the Safe Management and Disposal of LLW/ILW; 4.01/95 (Belgatom/Magnox).

- Preliminary Safety Assessment of the Radioactive Waste Treatment and Disposal Facility at Püspökszilágy; 4.12/95 (AEA Technology).

- Management of Spent Sealed Radioactive Sources in Central and Eastern Europe; AEA Technology United Kingdom, under contract B7-5350/99/6161/MAR/C2 from the European Commission, between 1999 and 2001.

An6.4 Reviews related to the remediation of the closed uranium mine

- Audit of the Investment Program for the Remediation Tasks of Abandonment of the Hungarian Uranium Industry; WISMUT GmbH Chemnitz, April 1999.
- Review of the Conceptual Plan for the Long-Term Tasks Following the Abandonment of Uranium Ore Mining - Developed by Mecsekérc; WISMUT GmbH Chemnitz, January 2002.

ANNEX 7: THE REMEDIATION OF THE CLOSED URANIUM MINE

An7.1 Precedents

During the processes of 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 Hills. A special infrastructure of mining needed for the mine opening and ore milling was developed, including the facilities, 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 1980s and the Government decided to close down the uranium industry. Production was terminated in 1997. On the basis of the decision, an Investment Programme for the remediation tasks of the Hungarian uranium industry was formulated, and its realisation commenced on 1st January 1998.

An7.2 Environmental remediation programme

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

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 a minimum the environmental damage in connection with the uranium ore mining, namely
  - protecting the Pécs potable water reserve;
  - lowering the harmful effects of the preterite mining and milling on human health to such a degree that the additional dose received by the workers should remain below the approved limit;
  - controlling the effects of contamination sources, ensuring the possibility of intervention if needed;
  - decreasing to the lowest possible minimum any future damage caused by the mining activities;
- optimum re-utilisation of areas and facilities utilised by the uranium industry:
  - decontamination of objects;
  - making the infrastructure suitable for other purposes;
  - creating new jobs through the above-mentioned issues;
- defining the costs of the planned closing down of uranium ore production and of the environmental remediation;
- appropriately scheduled, cost-effective accomplishment of the conception plan.

An7.2.2 Radiation protection requirements

Hungarian and international law and standards, the recommendations of the IAEA, and the practice of other countries played a determinant role in the elaboration of the requirements. The authorities established the environmental protection requirements for the planning and licensing process of the decommissioning and remediation activities in the environmental protection licence issued by the South Transdanubian Environmental Protection Inspectorate. The system is based on the document "Environmental impact assessment of uranium ore mining in the Mecsek" and the prescription of the Baranya County Institute of the State Public Health and Medical Officer's Service for the radiation protection requirements of remedial action.

In accordance with the environmental protection licence and the prescription of Baranya County Institute of the State Public Health and Medical Officer's Service, the following limit values for release and environmental load have to be maintained in the course of mine closure and remediation:

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

Rn exhalation:	0.74 $Bq/m^2/sec$
Rn concentration:	background + 20 Bq/m^3
Gamma-dose rate:	background + 200 nGy/h
Activity concentration in soil:	
in the top 15 cm thick layer:	background + 180 Bq/kg
in the underlying 15 cm thick layer:	background + 550 Bq/kg

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

Surface facilities	Rn exhalation	0.74 $Bq/m^2/s$
	Activity concentration in soil: in the top 15 cm thick layer	background + 180 Bq/kg
	Activity concentration in soil: below 15 cm in depth	background + 550 Bq/kg
Inside buildings	Rn concentration	background + 30 Bq/m^3
	Gamma-dose rate	
	average of workplace:	background + 200 nGy/h
	1 m from wall, floor:	background + 200 nGy/h
	Fixed alpha contamination (on floor and wall):	0.5 Bq/cm^2

An7.2.3 Inventory of the remediation programme

The completion of the inventory related to the area covered by uranium mining was a basic requirement for the planned accomplishment of the remediation activities. The main objects and facilities on the mining plots and elsewhere, and their characteristic parameters are the following:

- cavity volume of the 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 area: 44 ha
- volume of the two tailings ponds: 16.2 Mm^3

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

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

Table An7.2.4-1 Schedule of the remediation programme

Project Title	1998	1999	2000	2001	2002	2003	2004
Underground mines	■	■	■				
Facilities above ground	■	■	■	■	■		
Waste rock piles	■	■	■	■	■		
Heap leaching piles	■	■	■	■	■		
Tailings ponds			■	■	■	■	■
Mine-water treatment	■	■	■	■	■	■	■
Restructuring of electricity supply			■	■	■		
Water supply and sewage		■	■	■			
Infrastructure work	■	■	■	■	■		
Monitoring, miscellaneous activities	■	■	■	■	■	■	■

The decontamination of the tailings ponds, the mine-water treatment, the environment monitoring and other related activities are expected to go on for further decades. These tasks will be carried out in the framework of a post-remediation programme.

An7.3 Post-remediation tasks

The currently valid financial plan of the Investment Programme considers the necessary water purification, maintenance and monitoring costs up to 31st December 2004. These tasks will necessarily continue for an as yet undefinable period, for environment and health protection reasons and because of the prerequisite to protect the drinking water reserve.

The Government made responsible the Ministry of Economy and Transport for financing of long term tasks from 2003.

For the long-term success of technical interventions related to reclamation and environmental protection carried out according to the plans of the Investment Programme - and according to the prescriptions of the appropriate authorities - the extent of the various control-, monitoring-, and maintenance tasks that need to be carried out should depend on the nature and type of the given object.

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

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

The post-remediation tasks comprise two main areas, viz. environment monitoring and environmental protection operations. Environment monitoring includes field measurements, sampling, data recording, laboratory analyses, data processing, data interpretation and modelling activities. The provision of information to the authorities and the public is also an important task. Providing data to the public serves to promote re-utilisation of the area and the prevention of harmful effects until remediation is completed.

For environmental protection purposes the following long-term tasks are to be performed:

- uranium removal from the surface and groundwaters, (the capacity of the uranium removing plant is 1.5 million m^3/year water)
- desalinisation of groundwaters (1000-1200 m^3/day water is treated),
- maintaining the water purifying plants, and the decontamination and drainage systems,
- operating the unified water discharge system,
- maintenance and after-care of areas with limited utilisation.

Considerable after-care activity is expected on the tailings ponds: these are the largest and most sensitive objects considering the complexity of the cover layer. Biological reclamation will not be fully completed by the end of the Investment Programme in that the planting of trees and shrubs will continue.