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Comparison among different decommissioning funds methodologies for nuclear installations

Final Report

Country Report Hungary

on behalf of the European Commission
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Hungary

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Summary

Five nuclear installations exist in Hungary. Four of them: the Paks nuclear power plant, two research reactors in Budapest and the Intermediate Spent Fuel Storage Facility at Paks will be covered in this study, the fifth installation, a small shallow-land final disposal site for radioactive waste of non-NPP origin does not fall in the scope of this project. Following the instructions of the project management, the scope of our examinations was extended to the liquidated (decommissioned) uranium mine and ore mill in Kővágószőlős, near Pécs, Southern Hungary.

The earliest year when a decommissioning project will start in Hungary is 2023, but this date will probably be extended further on. The legal framework for decommissioning originates from the Act on Atomic Energy, passed by the Hungarian Parliament in 1996 as Act CXVI. From that time on, a structure of governmental and ministerial decrees and regulatory documents was elaborated. Detailed decommissioning plans are available for NPP Paks, however, only preliminary plans were submitted to the authority by the two RR's. The course of revising, updating and extending these plans goes on continuously, as a part of the Periodic Safety Reviews of the installations.

In Hungary the sole financial basis for all future decommissioning activities is the state-owned Central Nuclear Financial Fund (CNFF). The Hungarian Atomic Energy Authority (HAEA) is the authentic institution which is responsible for managing the CNFF. The CNFF is a segregated asset of the Hungarian State Treasury. Its increase is based on two main factors: the annual contribution of NPP Paks from its income (growth of the capital) and the annual accrual (yield of the capital) assigned by the annual budget and prescribed by the Act on Atomic Energy. In order to provide sufficient information a series of HAEA and PURAM reports and publications were studied, their list can be found in Chapter 7. Additional information was obtained from interviews with HAEA experts.

1 Introduction and overview

Hungary has a clear and declared policy for the further application of nuclear energy. It will play a key role in the energy production of Hungary in the 21st century. No figures are announced so far on the exact percentage of nuclear energy in electricity production; however, it is likely that its present share of approximately 40 % will not decrease. Decommissioning is considered as an inherent part of nuclear activities. The envisaged lifetime of the sole Hungarian NPP (Paks, 4 units 460 MWe each) will certainly be extended from 30 to 50 years. (Scheduled shutdown: 2032 -2037 instead of 2012 – 2017)

The two existing research reactors will operate at least for twenty more years.

The general decommissioning plan of NPP Paks is regularly revised as part of the Periodic Safety Review. The decommissioning plans of the two RR's are in initial state. The required activities and their conditions and circumstances are accurately determined in the appropriate legal documentation. The approved decommissioning plans assign the decommissioning strategy of primary consideration. It is *deferred dismantling* for NPP Paks and its neighbouring Intermediate Spent Fuel Storage Facility and *immediate dismantling* for the research reactors. The general purpose is the clearance of the whole site with certain further limitations ("brown field" status). The formal regulations are given in details in the "Nuclear Safety Codes", which is the annex of Governmental Decree 89/2005.

The Act CXVI of 1996 on Atomic Energy declared that the task of decommissioning be solved by the state of Hungary. This act and its consecutive decisions and decrees established the Central Nuclear Financial Fund (CNFF) for covering the costs of activities related to dismantling, decontamination, demolition etc. (decommissioning in the narrow technical sense) and the Public Agency for Radioactive Waste Management (PURAM) for taking over the tasks related to radioactive waste management and final disposal. Responsibility and liability for implementing all actions related to these activities is transferred to PURAM, costs are covered by the licensees. At least one year before the last operational licence of an installation expires the licensee is obliged to submit a licence request for decommissioning together with the final decommissioning plan. When it is approved by the authorities PURAM will be the licensee of these nuclear installations throughout the complete process of decommissioning. Following this transfer of responsibility PURAM is obliged to prepare execution plans and implement decommissioning. It is envisaged that this procedure will contain several consecutive steps of executive planning, authorisation and implementation until its approved endpoint ("green field" or "brown field") is reached. PURAM was established by the Hungarian Atomic Energy Authority (HAEA). HAEA is a national authority (its employees are public officers and servants) while PURAM is a publicly owned company with employees of the same legal status as any other publicly or privately owned company. As it will be given later in more details, the CNFF is managed by an assigned department of HAEA. Expenditures from the CNFF are transferred to PURAM on a case-by-case contractual basis.

Full titles of the act, decisions and decrees mentioned above:

- Act CXVI. (1996) “Atomic Energy Act”
- Decree of the Hungarian Government 240/1997. on establishing the CNFF
- Decision of the Hungarian Government 2414/1997. on establishing PURAM
- Decree of the Hungarian Government 89/2005. Annex: Nuclear Safety Codes

Nuclear installations of Hungary:

Paks Nuclear Power Plant – 4 460 MWe PWR units. The great majority of the shares of NPP Paks Co. (the licensee) belong to the state-owned Hungarian Electric Energy Co. (MVM Rt.) The NPP will operate till 2032 – 2037. Decommissioning plan was elaborated and is regularly revised. Last revision: 2003.

Budapest Research Reactor – 10 MWth research reactor using enriched uranium fuel. The licensee is the Atomic Energy Research Institute of the Hungarian Academy of Sciences. Envisaged termination of operation is not yet determined. The preliminary decommissioning plan was elaborated in 1997 – 1998.

Training Reactor of the Budapest University of Technology and Economics – 100 kWth research reactor with enriched uranium fuel. The licensee is the rector of the University. Envisaged termination of operation is not yet determined. The preliminary decommissioning plan was elaborated in 2004.

Intermediate Spent Fuel Storage Facility (ISFSF) – separate installation on the site of NPP Paks. The ISFSF is in operation since 1997. The licensee is PURAM. The present operating licence of ISFSF is valid for 50 years. Its decommissioning plan is closely related to that of NPP Paks.

Liquidated uranium mine and ore mill – located at Kővágószőlős, near the municipality of Pécs, Southern Hungary. The mine was closed in 1997, the decommissioning operations (site restoration and soil recultivation) started in 1998. According to the plans this should have been finished by 2002, the official termination time is 2008 now. This work was and is independent of the CNFF. The company responsible for the operations was the state-owned Mecsekérc Co. between 1998 – 2004, then the newly-formed Mecsek-Öko Co. took charge of the execution. The operations are financed by different governmental bodies.

The most important installation in terms of decommissioning costs will inevitably be NPP Paks due to its size and radioactivity content. No special reasons (accidents, extreme contamination etc.) are considered in this respect. The above mentioned five installations will be treated in the report.

2 Decommissioning strategies and costs

2.1 Current and past decommissioning activities

The principal goal for decommissioning the uranium mine near Pécs, Southern Hungary was the reaching of the “green field” in a relatively short period of time. The activities include

- the complete recultivation of mine tailings,
- the complete dismantling of the ore mill facility,
- the backfill, insulation and soil coverage of sludge ponds.

Components of the ore mill which had been declared radioactive waste were taken to the final radioactive waste disposal site at Püspökszilágy. The majority of the building material was treated and disposed of as normal (exempt) waste.

The “decommissioning” (this term has never been used officially for the liquidation of the uranium mine and ore mill) started at 1997 by the final decision of the Hungarian government to terminate uranium mining operations. (Governmental Decision 2085/1997.) The original date for completing the liquidation was 2002, then it was modified to 2004, the envisaged date now is 2008.

Decommissioning was executed by Mecsekérc Co. between 1997 – 2004. At that time this state-owned company was divided into two new, independent, state-owned companies: Mecsek-Öko Unopened Co. (UCo.) and Mecsekérc Environmental UCo. The former is in charge of the still ongoing decommissioning operations now. The operations are financed by the Hungarian State Property Agency (HSPA) on a contractual basis. The total estimated and devoted cost of the decommissioning is 80 M Euro, of which 6 M is left for future operations. Mecsekérc Co. obtained supports from the EU PHARE programme for the sludge pond insulation part of the project. The price basis was the detailed planning of the procedures by Mecsekérc Co. (Note that these operations are common in mining practice.) The difference between estimated and real costs was negligible, if the actual inflation rate (decreased from 10 % to 3 % per year in this period) is taken into account. The supervision of cost calculations was performed the same way as it is prescribed for companies owned by HSPA. Public control is provided as the entire budget of HSPA is determined by the Parliament as part of the annual national budget. Regular audits are held internally, by the State Account Office and also by the appropriate committee of the Parliament, the latter having only a rather formal significance.

2.2 Future decommissioning strategies

The principal strategy for NPP Paks is deferred dismantling with safe enclosure for 70 years. The main reason is the limited storage capacity for low- and intermediate level decommissioning waste, so an elaborated clearance procedure will be applied. Technical options have not been determined yet as the envisaged date of shutdown is 2032 – 2037.

The principal strategy for the two research reactors is immediate dismantling according to their preliminary decommissioning plan. The preliminary plans do not include any technical option.

The principal strategy of the ISFSF is immediate dismantling as it will be decommissioned together with NPP Paks after its safe enclosure period. The present operating licence terminates in 2047; the spent fuel will then be removed stepwise. The establishment of a final HLW storage site (see below) will probably have an influence on these proceedings.

A separate final disposal site (Bátaapáti – Üveghuta, 30 km from Paks) for the conditioned operational and decommissioning low- and intermediate level waste of nuclear installations is under construction (Planned completion date: 2010 - 2012). Projected capacity: 50 000 m^3. Type: geological disposal in granite (depth: 200 – 250 m below ground level), structure: shafts and vaults. Licensee: PURAM. In coping with the deferred dismantling option, the vast majority of the decommissioning waste will be declared as normal industrial waste following a clearance procedure. The calculated amount of LLW and ILW from decommissioning is 25 000 m^3.

The operating final disposal site at Püspökszilágy (40 km from Budapest) accepts low- and intermediate level waste of every nuclear and radioactive installation except for NPP Paks. Total capacity: 5000 m^3. It is practically 100 % full. Reloading, repacking and clearance operations of previously deposited waste are planned. Licensee: PURAM. No decommissioning waste can be deployed there.

Deep geological repository for high level waste and spent nuclear fuel: initial phase of geological research started in 1993 and terminated in 1999 when the 1100 m deep research site in claystone rock formation was abandoned. Research is continued in 2003, but a new research shaft has not been established yet. Research is financed by PURAM from the Central Nuclear Financial Fund (CNFF).

Waste processing activities:

NPP Paks: temporary storage of liquid and solid waste, volume reduction (compaction and evaporation) is regularly performed on-site. Conditioning (MOWA cementation) is planned and licensed on-site.

Püspökszilágy disposal site: temporary storage of liquid and solid waste, conditioning (cementation).

Start, expected end and expected duration of the different decommissioning stages is the following:

NPP Paks: Shutdown 2032 – 2037. Final decommissioning after 70 years of deferred dismantling/safe enclosure: 2102 – 2124.

ISFSF Paks: Licensed operation till 2047. Final decommissioning together with NPP Paks

BRR Budapest and TR Budapest: immediate dismantling after shutdown. Starting date: not determined yet (estimated 2030 – 2040). Duration: 10 – 15 years from shutdown.

Decommissioning activities will all be managed by PURAM. This institution is entitled to be the licensee of facilities and sites under decommissioning. However, the licensee of the operating facility is responsible for the detailed elaboration of the decommissioning plan including the preliminary cost estimates. As the consecutive major steps of decommissioning will probably require separate approvals by the authorities, the cost estimates of these steps will be determined by PURAM before submitting an actual licence application.

Cost estimates are to be included in the preliminary decommissioning plans of the facilities. Plans, as well as cost estimates are periodically reviewed. As the starting date of decommissioning activities is far away, detailed cost estimates have not been prepared yet.

No decommissioning has taken place in Hungary so far. A detailed cost estimation for the decommissioning of NPP Paks was elaborated by DECOM company (Slovakia). The other nuclear installations have only rough cost estimates based on international experiences are without taking into account the specific situation of the respective nuclear facilities (technical, economic, legal and social circumstances).

Cost estimates for NPP Paks and ISFSF Paks:

Direct decommissioning costs:	1300 M Euro
LLW, ILW and HLW disposal related to decommissioning	906 M Euro
Indirect costs (PURAM operational costs etc.)	317 M Euro
Total:	2523 M Euro

Cost estimate for the decommissioning of BRR Budapest:

Direct decommissioning costs:	2.6 M Euro
LLW, ILW and HLW disposal related to decommissioning	2.0 M Euro
Indirect costs (research etc.)	0.1 M Euro
Total:	4.7 M Euro

Cost estimate for the decommissioning of TR Budapest:

Total (rough estimate only):	1.0 M Euro

(See also Tables 1. and 2. below for details)

These estimated costs are given by HAEA. The authority considers the estimates from the actual preliminary decommissioning plan of NPP Paks (compiled and then updated by the Slovakian DECOM company) as well as the estimates of PURAM experts. Detailed cost estimates exist only for NPP Paks at the moment. The price basis is generally the “international practice”: reference data from finished and ongoing decommissioning projects are considered and altered in terms of the differences in terms of size and type of the appropriate facilities. The following techniques are all applied for cost estimation: analogies, order-of-magnitude estimate, and expert opinion technique. OECD/NEA studies and reports are mentioned as references. According to HAEA the experts of the Slovakian DECOM company applied generally accepted algorithms to estimate the decommissioning costs of NPP Paks. These details of their report have not been available to the authors.

The allocation of costs is given only in the form of principal items as given above. On a recent public appearance of leading HAEA officers the following cost breakdown was presented:

The deferred dismantling of NPP Paks considers that the first of the two dismantling phases, which are separated by a 70-year-long safe enclosure period will cost 72 M euro annually on average, while the same figure for the second phase is 60 M euro on average. The costs of safe enclosure are estimated as 2.4 M euro per year.

Cost drivers are not identified yet. The cost estimates are annually modified with the actual inflation rate of the Hungarian currency. Its value is approximately 3 % at the moment.

The public control of cost estimates is provided by the regular audits of the State Account Office. Annual hearings held by the appropriate committee of the Hungarian Parliament also deal with this issue in a certain extent. Accounts are provided by the special committee of CNFF (formerly by the special committee of the Hungarian Atomic Energy Commission, but this body ceased to exist in 2003).

In Table 1 and 2 below we summarise the available data on the future decommissioning of the Hungarian nuclear installations. Table 1 deals with NPP Paks and ISFSF Paks, Table 2 deals with the two research reactors.

Table 1 Expected future decommissioning costs for NPP Paks (4 units of 460 MWe each)

Decommissioning activity	**Years the activity is expected to take place**	**Total decom-missioning costs [Mio. Euro]**	**Annuity of de-commissioning costs in relation to output over lifetime [ct/kWh; 4%]**	**Remarks #e.g. with regard to time horizons and in-terest rates used for calculation, or with regard to the question in how far any transport between proc-essing facilities is taken into account#**
1. Facility shutdown and pre-decommissioning activi-ties	2032 – 2037	28	0.7 ct/kWh (95 M euro in 2005)	
2. Spent fuel management (interim storage, reproc-essing, waste solidification, storage processed waste streams and disposal of high level waste or spent fuel as such covering the whole lifetime of the NPP)	2006 – 2087	237 + 763		first item is considered as operational cost
3. Management of other radioactive waste from op-eration of the NPP (processing, storage and disposal of low and intermediate level waste from operation) covering the whole lifetime of the NPP	2006 – 2124	143 + 143		50 % is considered as operational cost
4. Safe enclosure	2032 - 2102	168		
5. Dismantling (nuclear) and decontamination activi-ties for NPP Paks and ISFSF Paks	2102 – 2124	1104		
6. Decommissioning waste management (processing, storage and disposal of radioactive waste from de-commissioning)	2032 – 2124	included in line 5.		
7. Decommissioning of non-radioactive parts (conven-tional dismantling)	2032 – 2124	incl. in line 5.		
8. Site restoration, cleanup and landscape	2102 – 2124	incl. in line 5.		
9. Supporting programmes for employees	?	-		Details are not elaborated yet
10. Supporting programmes for regional development	2006 - ?	129 + 129		50 % considered as operational cost
11. Management costs of PURAM	2006 – 2124	188 + 188		50 % considered as operational cost
TOTAL		***2523***		

Source: Fifth mid- and long-term plan of Public Agency for Radioactive Waste Management (PURAM) for the activities to be financed from the Central Nuclear Financial Fund (CNFF). (in Hungarian) Paks, Hungary, July 2005.

Table 2 Expected total costs of future decommissioning of nuclear installations in Hungary (in prices of 2004)

Short name of nuclear facility #grouping for types of facilities possible – as in Table 1#	**Kind of facility:** **NPP = nuclear power plant** **RR = Research reactors** **Others: please specify**	**Years decommissioning activities are expected to take place**	**Total decommissioning costs estimated [Mio. Euro]**	**Annuity of estimated decommissioning costs in relation to output over lifetime [ct/kWh for NPP; 4%]**	**Remarks**
BRR Budapest	RR	from 2023 as earliest	4.7	not applicable	only preliminary plan exists
TR Budapest	RR	from 2027 as earliest	1.0	not applicable	only preliminary plan exists

Source: Fifth mid- and long-term plan of Public Agency for Radioactive Waste Management (PURAM) for the activities to be financed from the Central Nuclear Financial Fund (CNFF). (in Hungarian) Paks, Hungary, July 2005.

3 Funds and fund management

3.1 Setting aside funds

Since all nuclear installations are 100% owned by the State of Hungary, the state is responsible for providing the costs. (The related acts, decrees and decisions are listed in Chapter 1.)

The funds are generated

- From the annual contributions to CNFF by NPP Paks. This is determined by HAEA considering the up-to-date cost estimates and the actual and expected discount rate;
- From the contribution of the annual national budget when decommissioning of the minor nuclear installations will start.

CNFF covers the costs of radioactive waste disposal of operational waste as well. In order to keep the value of CNFF for the time it will be utilised, a valorisation mechanism is in place. This means that

- HAEA, the manager of CNFF calculates the expected annual accrual of CNFF on the basis of the actual inflation (discount) rate and the annual yield of bonds guaranteed by the state, considering the expected time left for collecting the funds before the actual start of its exploitation and the last available version of the respective decommissioning plans containing an updated and approved cost estimate;
- Then the annual budgetary act passed by the Parliament will include this accrual and assigns it to CNFF.

Although decommissioning is definitely a public liability, this mechanism is applied in order to provide safety against financial fluctuations caused by prompt and uncertain economic and political factors affecting the national budget and overall financial balance. The details of the management of CNFF are governed by internal regulations of HAEA, they were elaborated parallel with the establishment of the legal conditions.

PURAM is entitled to be the licensee of facilities and sites under decommissioning. The licensing procedure is clearly defined in the Nuclear Safety Codes which is an annex of Governmental Decree 89/2005. In the operational phase the present licensee of the facility is responsible for the detailed elaboration of the decommissioning plan.

Cost estimates are to be included in the preliminary decommissioning plans of the facilities. Plans as well as cost estimates are periodically reviewed. As the starting date of decommissioning activities is far away, detailed cost estimates have not been prepared yet. Cost estimation is provided by the present-day licensee when the updating of the appropriate decommissioning plan is due. This is submitted to, then is revised and accepted by HAEA the same way as other authorisation and licensing activities. Accountancy of CNFF is provided by HAEA and revised by the State Account Office the same way as all state-managed funds are revised.

The method and structure of collection of CNFF was defined in Act CXVI of 1996, 14 years after the start-up of the first unit of NPP Paks. Collection is planned to end at shut-down. According to the managers of CNFF, the annual contribution paid by NPP Paks is iterated every year in order to assure that the funds will be sufficient in the end. A certain part of CNFF is regularly exploited for radioactive waste management and other purposes (operation of PURAM, research of potential waste disposal sites etc.). Sufficient funds will be available at the beginning of decommissioning. The decommissioning costs of the two RR's will be covered by the annual national budgets of the appropriate period. For these much lower expenditures no preparatory fund-raising measures are determined.

The licensee of NPP Paks transfers the annual contribution to the CNFF in the form of bank transfer to a separate account of the Hungarian State Treasury. Clients of PURAM pay for the reception of their operational radioactive waste in the regular special way of accounting for public services (e. g. no value-added-tax is accounted for in this case.) A detailed price list is elaborated for such activities. These payments are also considered as part of CNFF, but their amount is negligible compared to the annual contribution of NPP Paks and the requirements of future decommissioning.

NPP Paks adds the amount of its annual contribution to CNFF to its operational expenditures, so it becomes part of its selling price and thereafter of the price of electricity finally paid by consumers. The price of electricity for the consumers is defined by the Hungarian Electric Energy Co. (its ownership and its relation to NPP Paks were already described in Chapter 1.) and approved the Government. The price for the consumers is determined as an average of the individual selling prices of the suppliers. These suppliers are the owners of power stations of the country and companies importing electricity from abroad. The present selling price of NPP Paks is the lowest of them all.

3.2 Management of funds

According to the respective legal instructions, The Hungarian Atomic Energy Authority (HAEA) manages the fund (CNFF). As it was introduced above, the institution responsible for the execution of decommissioning is PURAM. Institutionally, PURAM has a Public Agency status. It was founded by HAEA as it was entitled to do so by the Governmental Decision 2414/1997. The Governmental Decree 240/1997 and the Governmental Decision 2414/1997 clearly announce that this fund constitutes internally and publicly managed and segregated means for accomplishing the decommissioning of nuclear installations in Hungary. However, the value of the annual accrual depends on the politically influenced decision of the Parliament, so it is possible (it happened once since the establishment of CNFF) that the accrual is not provided.

Technically, the CNFF is a separate state fund in the Hungarian State Treasury. HAEA transfers regularly certain amounts of the CNFF to PURAM for their operational, waste management and R & D costs on a clearly defined contractual basis. Annual plans are elaborated and approved by HAEA management. Public hearings and audits are held as described above already. Regulations are those of nation-wide authorities for financing their affiliations which are publicly owned but not authoritative institutions. In turn, PURAM is entitled to accomplish its tasks either by direct utilisation of the transferred sums or by calls for tendering and competitive bidding open for national and international companies as well.

In order to ensure that the CNFF maintains and improves its capability for covering decommissioning expenditures, the expected “investment profit” is calculated considering the actual assets in the CNFF and the annual base interest rate of the National Bank of Hungary. This accrual is assigned by the annual budgetary law.

The annual contribution from NPP Paks and the annual accrual from the national budget are supposed to iterate towards the final goal: covering all the costs of decommissioning when they will arise. This structure does not involve any liquidity requirements with regard to the money invested, this is substituted by the regular updating of cost estimation, contributions and accruals.

The internal control is accomplished by the CNFF special committee the members of which are assigned by the director general of HAEA. The annual account and the working program for the forthcoming year of the CNFF special committee are submitted to the minister responsible for supervising the HAEA (at present: Minister of Justice and

Law Enforcement). External control is provided in several ways. The State Account Office regularly revises the financial operations of HAEA as it was mentioned already. “Political” control is provided by the Minister supervising the structural and financial operation of HAEA (at present, this is the Minister of Justice) and by the annual hearings of the appropriate parliamentary committee.

The state of CNFF (in the form of “Annual Mid- and Long Term Plan of PURAM for Activities Financed from the CNFF”) is reported annually to the Minister of Justice (formerly: the Minister of Interior and the Minister of Economics) who controls the finances of the HAEA and therefore to the Government and the Parliament. This report describes the financial policy of HAEA concerning the utilisation of CNFF and the presumed expenditures on decommissioning and waste management. Short-term reports are submitted to HAEA by PURAM reflecting the actual status of the ongoing investment projects. Except for the direct and indirect expenditures of PURAM nothing else is allowed to be covered from the CNFF. The CNFF is a separate state fund in the Hungarian State Treasury, but the assurance of its existence and the inflow of the annual accruals is not bound to explicit investment operations, e. g. bonds. Therefore, “benefits” and “profitability” of the CNFF cannot be defined separately from the general status of the Hungarian State Treasury.

The destination of a certain amount deposited in the CNFF is determined by HAEA. A possible misuse of the funds (e. g. investing into a project other than radioactive waste management or decommissioning) must be revealed by the previously described structure of internal audits, examinations of the State Account Office and hearings of the appropriate parliamentary committee. Loss of CNFF (e.g. owing to an accident or other external reason) cannot be reimbursed from insurance since insurance cannot be applied to state-owned institutions according to Hungarian laws.

3.3 Special cases: Fall-back option and transfer of ownership

The existing plans of PURAM and HAEA for the utilisation of the CNFF do not consider the “fall-back” option. In this case the existing CNFF should be used; the remaining costs would be covered by the national budget. Responsibility would be transferred to PURAM similarly to the case of “normal” decommissioning. The actual ownership of this presumed shutdown facility is not influenced by the regulations, but it is mandatory that the licensee can only be PURAM as soon as the decommissioning licence is released. The preparatory steps of this licensing procedure in case of the “fall-back” option are not elaborated yet.

It is possible that the ownership of an operating installation (e. g. NPP Paks) is transferred in the future, e.g. privatisation will take place. If the ownership of NPP Paks is transferred, the new owner (the new licensee) will be liable to continue to pay the annual contribution to the CNFF. As this obligation is stated in Act CXVI. (1996), it is likely to be obeyed by everyone.

Table 3 Base for decommissioning funds required

Short name of nuclear facility **#grouping for types of facilities possible – as in Table 1#**	**Kind of facility:** **NPP = nuclear power plant** **RR = Research reactors** **Others: please specify**	**Please check if decommissioning funds are based on overnight / undiscounted decommissioning costs**	**Please check if decommissioning funds are based on net present value / discounted decommissioning costs**	**Discount rate used for discounting, if any**	**Reference date used for discounting**	**Remarks**
NPP Paks	NPP		+	3 % in 2004	The discount rate is re-calculated every year.	
ISFSF Paks	SF storage site		+	same as above	same as above	
BRR Budapest	RR			-		Decommissioning costs will be provided when they arise.
TR Budapest	RR			-		Decommissioning costs will be provided when they arise.

Table 4 Decommissioning funds accumulated in relation to expected total costs of future decommissioning of nuclear installations in Hungary (in prices of 2004)

Short name of nuclear facility **#grouping for types of facilities possible – as in Table 1#**	**Kind of facility:** **NPP = nuclear power plant** **RR = Research reactors** **Others: please specify**	**Total decommissioning costs estimated [Mio. Euro]**	**Provisions accumulated by 31-12-2004 [Mio. Euro]**	**Provisions accumulated in relation to expected costs [%]**	**Years of operation until 31-12-2004 in relation to total expected lifetime [%]**	**Remarks #e.g. with regard to time horizons and interest rates used for calculation#**
NPP Paks	NPP	2523	261	11	46	increase of CNFF in 2004: 71 M euro
ISFSF Paks	SF storage site	together with NPP	together with NPP Paks	together with NPP	10	
BRR Budapest	RR	4.7	will not be financed from CNFF	--	< 72	
TR Budapest	RR	1.0	will not be financed from CNFF	--	< 61	

Source: Fifth mid- and long-term plan of Public Agency for Radioactive Waste Management (PURAM) for the activities to be financed from the Central Nuclear Financial Fund (CNFF). (in Hungarian) Paks, Hungary, July 2005.

Table 5 Management of decommissioning funds in Hungary

Short name of nuclear facility **#grouping for types of facilities possible – as in Table 1#**	**Kind of facility:** **NPP = nuclear power plant** **RR = Research reactors** **Others: please specify**	**Provisions accumulated by 31-12-2004 [Mio. Euro]**	**… of which has been accumulated within the own assets of the operator of the facility or its mother company [Mio. Euro]**	**… of which has been accumulated by the operator of the facility or its mother company within a separated account / segregated fund [Mio. Euro]**	**… of which has been accumulated in an external fund under public control [Mio. Euro]**	**… of which has been accumulated in an external fund under mixed private-public control [Mio. Euro]**	**Share of funds the operator of the facility can access for other activities until the funds are needed for their original decommissioning purpose [%]**	**Remarks**
NPP Paks	NPP	261	-	-	261	-	0 %	The present operator cannot be the licensee of decommissioning activities.
ISFSF Paks	SF storage	together with NPP						PURAM is the operator of ISFSF
BRR Budapest	RR	--						The present operator cannot be the licensee of decommissioning activities.
TR Budapest	RR	--						The present operator cannot be the licensee of decommissioning activities.

Source: Fifth mid- and long-term plan of Public Agency for Radioactive Waste Management (PURAM) for the activities to be financed from the Central Nuclear Financial Fund (CNFF). (in Hungarian) Paks, Hungary, July 2005.

Table 6 Investment of decommissioning funds until they are used for their original purpose #information has to be added#

Short name of nuclear facility #grouping for types of facilities possible – as in Table 1#	Kind of facility: NPP = nuclear power plant RR = Research reactors Others: please specify	Provisions accumulated by 31-12-2004 [Mio. Euro]	… of which have been invested in secure state bonds [Mio. Euro]	… of which have been invested in other assets with fixed interest rates [Mio. Euro]	… of which have been lent to associated or joined companies or to third parties [Mio. Euro]	… of which have been invested in other means (shares, mergers & acquisitions, etc.) [Mio. Euro]	Interest on invested financial means from decommissioning funds in 2004 [%]	Interest on invested financial means from decommissioning funds in period 2000-2004 [%]	Remarks
NPP Paks	NPP	261	261	-	-	-	not defined	not defined	CNFF is a segregated part of the assets of the Hungarian State Treasury.
ISFSF Paks	SF storage	together with NPP Paks	together with NPP Paks						
BRR Budapest	RR	-							Decommissioning costs will be given to CNFF by the state when operations will start.
TR Budapest	RR	-							Decommissioning costs will be given to CNFF by the state when operations will start

Source: Fifth mid- and long-term plan of Public Agency for Radioactive Waste Management (PURAM) for the activities to be financed from the Central Nuclear Financial Fund (CNFF). (in Hungarian) Paks, Hungary, July 2005. Detailed data will be achieved from HAEA.

4 Transparency of the funding schemes to the public

In general, the decommissioning strategies and responsibilities are transparent to the public, however there is not any direct public participation in the decision process on decommissioning funding.

The reports concerning the activities of PURAM are submitted to the appropriate committee of the Hungarian Parliament, so they are fully transparent, and they are available from the internet. Summary of the status of the decommissioning plans (including decommissioning strategies) are presented in these annual reports. The plans themselves are not transparent to the public, but contracts of the PURAM financed from the Central Nuclear Financial Fund are transparent, they are available from the internet as well. The annual budget of CNFF is an integrated and thus fully transparent part of the annual budget of the State of Hungary.

PURAM has to submit a proposal for the long and intermediate term plans, as well as an annual plan. These contain information also about CNNF, e.g. the funding scheme, state of funds and fund investment. These will be evaluated by the special committee of CNFF and submitted to the director general of HAEA and then to the ministry supervising HAEA. The plans negotiated by this way are to be approved by the Minister supervising the HAEA who submits the plan for approval in the yearly budgetary law. Following the approval by the Parliament the tasks are to be carried out.

Besides the legal requirements, it is mandatory to keep the public informed on a permanent basis of all actions and measures taken. This responsibility involves not just disseminating information but also setting up dialogue with the population and the local, regional bodies involved in the proposed choice of a disposal site or the site for interim storage of spent fuel.

It is of particular importance to obtain widely based social understanding and support for the efforts. The biggest challenge for experts and scientific community is how to raise the level of social trust in its ability to understand the potential environmental impact.

A great effort has been made during the last years. Not only new web pages were developed, but social organizations were established with the participation of several villages located near to the Paks NPP and around the operating and planned final radioactive waste disposal sites.

First of these organizations (called Social Control and Information Association – TEIT) was established with the participation of 13 villages located within 12 km radius of the Paks Nuclear Power Plant in 1992 on the initiative of the Paks Nuclear Power Plant. These organizations will be involved in the project of decommissioning from its beginning.

When decommissioning plans will be carried out, the regular legal framework of public participation has to be applied including e.g. public hearings and the approval of local authorities for the Environmental Impact Assessment.

5 Stakeholder analysis

The relevant stakeholders in Hungary with regard to decommissioning financing are the following:

- Hungarian Atomic Energy Authority (HAEA) and the Public Agency for Radioactive Waste Management (PURAM). The minister, who supervises the HAEA (at present: Minister of Justice and Law Enforcement), is responsible for the operation of the Fund and through the HAEA – as the manager of the Fund – controls the implementation of the management tasks associated with the operation of the Fund. PURAM calculates the annual contribution to the Central Nuclear Financial Fund and HAEA supervises the activities of PURAM. HAEA is responsible for the accruals of the assets. HAEA is interested in the safe and sufficient increase of CNFF as it is a relevant component of overall nuclear safety
- Paks Nuclear Power Plant (NPP Paks) and its owner: MVM Co. The NPP is responsible for paying into the Central Nuclear Financial Fund the sum covering all the expenditures of decommissioning before the shut-down of the NPP. The annual contribution in 2005 was 91 M Euro, in turn this is included in the price of electricity.
- State of Hungary. Supervision of the HAEA, on behalf of the Government, is performed by the designated member of the Cabinet, – at present the Minister of Justice – independently of his portfolio-related functions. The Government is responsible to preserve the value of the Central Nuclear Financial Fund.
- Training Reactor of the Budapest University of Technology and Economics, the licensee is the rector of the University.
- Budapest Research Reactor, the licensee is the Atomic Energy Research Institute of the Hungarian Academy of Sciences.

Representatives of HAEA, Paks NPP, Training Reactor and Budapest Research Reactor were asked about their opinion with regard to the decommissioning fund. In general, there isn't any suggestions to change the system nowadays.

As a result of the parliamentary election, the Hungarian governmental structure will be changed that possibly indicates changes in the status of the HAEA. Since these changes could occur during the next months, their opinion could have not been taken into consideration. However, as the CNFF constitutes a special and segregated budgetary item, the government is interested in its safe management and – on the other hand – is prohibited to mix it with other financial means for short-term purposes of the national budget. Sometimes these elements are contradictory.

HAEA considers the existing regulations and financing scheme are sufficient for secure long-term decommissioning funds. They think this is “the best possible” system.

BRR satisfied with the existing schemes and regulations, they think the methodologies of estimating decommissioning costs are sufficient. However, they consider this project very important, “we have to think about these questions right now!”

HAEA and BRR agree with the methodologies of estimating decommissioning costs, Training Reactor is of the opinion that it is undue and complacent that the state budget does not contribute to the CNFF for providing the decommissioning costs of the state-owned research reactors in the same manner as it is done in the case of NPP Paks. There is no certified cost estimation method in place for defining the accurate decommissioning costs for the training reactor of the BUTE. A relevant improvement can be achieved when the details of the spent fuel removal and storage will be elaborated. BRR satisfied with the existing system. They said: “since the research and training reactors are state-owned and their operation is financed from the central budget, it is obvious that decommissioning costs will be paid into the CNFF by the Hungarian Government when the costs arise.”

All of the stakeholders agree that there is adequate provision for future financing of safe decommissioning activities. Decommissioning plans and costs are regularly revised. However Training Reactor believes that the only way for assuring a sufficient capital for decommissioning the research reactors is the appropriate extension of CNFF. The present solution for the two research reactors (direct financing of the actual procedures from the annual state budget) seems rather inadequate.

All of the stakeholders agree that funds are and will be available when the money is needed. The utilisation of CNFF is regularly revised by HAEA and discussed publicly at the annual parliamentary hearing. Although there is no insurance to cover financial risks, this technique is acceptable.

All of the stakeholders agree that funds are properly managed. The CNNF is a separate state fund in the Hungarian State Treasury and 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. Stakeholders said this practice was interrupted for 2001-2002 by a faulty parliamentary decision, but they hope it could never happen again. They said, this indicates the responsibility of the government and the Parliament.

The transparency of the scheme to the public is also regarded as sufficient by the stakeholders. Interim and long term plans and contracts of the PURAM are published on the internet.

Stakeholders were asked about the possibility of regional waste disposal, too. HAEA told there is not any final decision about the back-end of the fuel cycle in Hungary. There are several possibilities and regional waste disposal is one of them. This is not an issue today. The Preliminary Decommissioning Plan is not dealing with this possibility, Hungary considers to solve these tasks within the country

BRR thinks that this would be the best solution, but political decision is necessary. Training Reactor said that *regional waste disposal is not applicable according to the present Hungarian legal framework, as far as the acceptance of „foreign" waste is concerned. However,* the concept of regional waste repositories fits well into the future cooperative structure of a united Europe.

Stakeholders do not know any expected future changes of the decommissioning funding schemes and regulations and there is not any proposals for changes on the national level. They do not know any planned future changes on the European level, however they think this would be very important. They said, according to their knowledge, there was no uniform EU policy or practice for operating these funds. A guidance of this kind would be extremely helpful. HAEA said, "equal conditions for competing on the international electricity market are important, but harmonisation of the management of funds may be difficult, because of the differences among the Member States."

6 Conclusions and recommendations

Future decommissioning projects in Hungary are to be financed from the assets collected in the country's Central Nuclear Financial Fund (CNFF). The Fund – a segregated part of the Hungarian State Treasury - is managed by the Hungarian Atomic Energy Authority. The system of raising the CNFF funds is

- Well elaborated, transparent and generally safe;
- Based on the payment of NPP Paks (thus indirectly from the price of electricity sold by NPP Paks to the Hungarian Power Companies Ltd.) and the annual contribution of the state budget, substituting the role of "investment profit" that can be related to "active" kinds of assets.

The minor costs of RR decommissioning should be embedded more efficiently into the system of contribution to CNFF. Parallel to the revising and refining of decommissioning plans, the funding mechanism has to be revised periodically as well. As the present system of fund-raising is strictly bond to legal prescriptions and procedures, this system is less versatile in terms of unforeseen changes of the basic circumstances.

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Annex

Sixth mid- and long-term plan of Public Agency for Radioactive Waste Management (PURAM) for the activities to be financed from the Central Nuclear Financial Fund (CNFF). Paks, Hungary, July 2006. (Submitted to and approved by the Hungarian Parliament)

Approved by:

Dr. József PETRÉTEI
Minister

2006. …………….

THE SIXTH MID AND LONG TERM PLAN OF PUBLIC UTILITY FOR RADIOACTIVE WASTE MANAGEMENT

FOR THE ACTIVITIES TO BE FINANCED FROM THE CENTRAL NUCLEAR FUND

May 2006.

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Table of content

1. INTRODUCTION

According to Article 40 of the Act No. CXVI. on Nuclear Power from 1996 (hereinafter referred to Nuclear Act) a body appointed by the Government will be responsible for dealing with tasks related to the final disposal of the radioactive wastes, interim storage and final disposal of spent nuclear fuel, furthermore with the issues related to the decommissioning of the nuclear facility, since the solution of the said tasks are of national interest.

The Government has entrusted the HAEA to establish, for executing the said tasks, the Public Utility for Radioactive Waste Management (hereinafter PURAM). In addition in Article 2 (1) c of Governmental Order No. 240/1997. (XII. 18.) it is required within the scope of the planning and reporting activities to prepare mid and long term plans for the activities to be financed from the Fund and of the income sources of the Fund as well as the annual review of them.

According to Article 62 (1) of the Nuclear Act the performance of the tasks will be financed from the Central Nuclear Financial Fund (hereinafter: CNFF or fund) existing as separated state financial fund. The minister supervising the Hungarian Atomic Energy Agency (hereinafter HAEA) has the responsibility for the fund; the HAEA is the manager of the fund.

The systematic review of the mid and long term plans and of the cost estimations is justified by the need of having realistic coverage from the CNFF for the potential costs that will arise in the distance future. Thus it is possible to enforce the basic principle of having the generation using the nuclear power to pay for the costs arising in the future and related to this utilization without leaving unjustified burdens to the next generations.

The sixth mid and long term plan of PURAM is functionally linked to the cost estimations prepared earlier, which were first made by Paks Nuclear Power Plant Ltd. (hereinafter Paks NPP,) while later on by PURAM.

The present plan is not taking into account the effects connected to the potential extension of operational life-time and increase of power output, because their Authority licensing has not yet been completed.

The most important target of the mid and long-term plan of the activities to be financed from the CNFF is actually the justified, transparent, but unambiguous determination of the level of the contributions to be paid to the Fund.

In the next coming years we are anticipating such changes which will have significant influence on the amount to be paid to the CNFF. Among the factors causing the changes one can list the prolongation of the operational life-time of the power plant, the consideration of the country specific cost factors in relation to disposal of the high level radwastes and of the spent nuclear fuel, the anticipated decrease of the value added tax, the re-consideration of the system of promotions provided to the public, as well as the updating of the discount rate taken into account for the calculations.

The above mentioned changes will take place at different moments of time and thus they would also affect the payments to the Fund in several steps, in a shock-like form. The significantly changing (increasing or decreasing) payments could soundly modify the consumption price for electricity. In order to avoid this, the above mentioned influences will be taken into account by our Company at the time of introduction of the European Union currency in Hungary, and at the time of completion of the licensing procedure related to the operational life-time extension. The effects of the different changes are continuously analyzed by PURAM. When the analysis will achieve their final form, they will be step by step incorporated into the mid and long term plans, in such a manner that the effect of the changes on the payments would first appear in 2010. As a consequence of this the payments on behalf of the power plant will remain nearly constant until 2009. Based on the preliminary estimations taking into account the listed factors in a joined manner will probably grant and even transition from the point of view of the amount to be paid by the power plant beginning from 2010, and thus the consumption price of the electricity will not change significantly either.

The mid and long term plan deals separately with the issues related to the spent fuel management generated in the nuclear facilities operated by institutions financed by State Budget (training reactor of the Budapest University of Technical and Economical Sciences, Institute of Nuclear Technology [BME NTI] and the research reactor in the Atomic Energy Research Institute of the Central Physical Research Institute [KFKI AEKI]) and the decommissioning of the said facilities, since in relations to those institutions the source is granted by payments into the Fund by the central budget in the year of the arise of the costs.

2. Analysis of the source side and storage possibilities of radioactive wastes and of spent nuclear fuels

2.1. Definitions

Radioactive waste: according to article 2. § m) of the Nuclear Act it is such a radioactive material not intended for further utilization, which cannot be handled as ordinary waste due to its health physics characteristics.

Spent nuclear fuel: according to article 2. § 1) of the Nuclear Act it is nuclear fuel used in the nuclear reactor, which, due to its potential reuse out of nuclear reactor, cannot be deemed as waste.

The classification of the radioactive wastes is carried out in accordance with Appendix 2 to the Order No. 47/2003 (VIII. 8.) ESzCsM (Ministry of Health, Social Policy and Family Care).

Those radioactive wastes are qualified as low and interim level radioactive wastes in which the heat generation during disposal (and storage) is negligible.*

Those low and interim level radioactive wastes are qualified as short-living ones, in which the half-life of the radio-nuclides is 30 years, or shorter, and includes long-living alpha-radiating

* Within the Hungarian regulation the standard MSZ14344-1 re-issued in 2004 provides guidelines, by determination of those levels of the heat generation which shall be taken into account in course of storage (disposal). According to this in the case if the heat generation of the waste is less than 2 kW/m^3, then it might be disposed as low and interim level radioactive waste.

** Within the Hungarian regulation the standard MSZ14344-1 re-issued in 2004 provides guidelines, by determination of those levels of the heat generation which shall be taken into account in course of storage (disposal). According to this in the case if the heat generation of the waste is more than 2 kW/m^3, then it might be disposed as high level radioactive waste.

radio-nuclides only in small concentrations (this concentration might be 4000 Bq/g in case of one collective package, and 400 Bq/g in average for the total amount of wastes).

Those low and interim level radioactive wastes are qualified as long-living ones, in which the half-life of the radio-nuclides and/or the concentration of the alpha-radiating radio-nuclides exceed the limit values set forth for the short-living radioactive wastes.
Those radioactive wastes are qualified as high level wastes, the heat generation of which shall be taken into consideration during planning of the storage and disposal and the operation.*

The Authority might prescribe more detailed, than above described classification for the low, interim and high level radioactive wastes.

For the classification of the low and interim level radioactive wastes the following aspects are taken into account:

The classification of the radioactive wastes into low and interim level classes shall be performed on the basis of the activity concentration of the included radio-isotopes, and on the basis of the exemption activity concentration (Table 2.1.1.). The values of the exemption activity concentrations for the different isotopes are given in order No. 23/1997. (VII. 18.) NM (Ministry of Public Health).

In the case if the radioactive waste contains several types of radioactive isotopes, then the classification shall be performed in accordance with Table 2.1.2.

In the present document the high level and/or long life-time radioactive wastes – since in long term they require similar treatment – are hereinafter simply referred to as high level radioactive wastes.

2.2. The stored material quantities and the storage capacities

Within Hungary, radioactive waste is finally disposed only in Radioactive Waste Processing and Storage Facility (hereinafter RWPS) operating in Püspökszilágy.

On site of Paks Nuclear Power Plant low, interim and high level radioactive wastes as well as spent fuel assemblies are temporarily stored. The fuel assemblies burnt in the reactor during the process of power generation are loaded for minimum 3 years to the cooling ponds, from where they are transferred to the Interim Spent Fuel Store (hereinafter ISFS) for 50-year-long interim storage. By 1998 there were 2331 spent fuel assemblies shipped back to the Soviet Union, and later to Russia, respectively.

Beyond that in Hungary there are such facilities of users of isotope and radiation sources, where exhausted radiation sources are temporarily stored, however – since later or sooner they will be transported to the RWPS – they are not treated in the present document.

Table 2.2.1 indicates the quantities of the radioactive wastes disposed of temporarily and finally on RWPS and Paks Nuclear Power Plant sites, together with spent fuel assemblies; as well as the utilization of capacities of the storage facilities as of January 1, 2006.

Comments to Table 2.2.1:

A) The storage capacity of the Püspökszilágy RWPS is provided in its gross volume. In this repository packages of different forms were disposed (e.g. 200 liters drums, 400 liters drums, special containers, bagged packages, etc.). Due to the non-perfect volume filling the disposed waste occupies more place, than the actual volume of the waste. It is not indicated separately in the Table, that in case of the RWPS there is available the reconstructed operational building suitable for temporary storage of the arriving wastes, where 800 drums of 200 liters might be located.

B) Concerning the intermediate storage created on site of Paks Nuclear Power Plant for disposal of low and interim level radwastes in solid form the value of the storage capacity is expressed in 200 liters drums, since this form of packing is the most common in the practice of the power plant. Within that the followings shall be mentioned:
- The slight change in the solid waste storage capacity of Paks NPP in comparison to the value given in the previous year can be explained by technological changes.
- The Table provides no information about the below listed storage capacities, since they are not intended by the operators of the power plant for location there of 200 liters drums:
    - that pool of room VK 302/I, in which storage of cemented liquid waste is planned, the capacity of this would provide possibility for storage of 336 pieces of 400 liters drums. (The modification of this room might be on the agenda in the future. The capacity to be created so would be suitable for placement of approximately 730 pieces of 200 liters drums, however thus the storage capacity for the cemented wastes, which will be needed in the future, would be lost.)
    - that part of room VK 302/I, where 20 storage containers of cesium-filter columns could be placed.
    - The pool of room VK 302/I with dimension of 5 x 8 x 11 m, which is maintained for storage of waste packages including large dimension wastes.

C) Concerning the data relevant to tanks created for storage of liquid low and interim level radwastes on site of Paks NPP the following remarks are applicable:
- The indicated storage capacity (9950 m^3) is relevant to the storage volume, which might be utilized in normal operational manner.
- In addition to that the volume of the emergency tanks constitutes further (550 + 400 + 550) 1530 m^3. (The nominal storage capacity of the emergency tanks is lower, than this value, i.e.: 550 + 380 + 550 = 1480 m^3.)
- This tank storage capacity has been created as a consequence of the extension performed in 2005 after the accident in 2003.
- The total stored quantity does not include the volumes of the transport waters used for transportation of the resins. The quantity of the transport waters is approximately 500 m^3, however, in the future it will not be necessary to treat the whole volume as waste, since due to the future evaporation only a few m^3 of waste will be generated. (Earlier the total quantity of the transport waters was kept in records as waste.)

D) In relation to storage capacity created for storage of high-level radwaste on site of Paks NPP the following remarks shall be made:
- The indicated capacity is related to the so called tube-wells created for storage of high-level radwaste.
- The waste volumes indicated in the Table are given in gross volumes (i.e. indicating the volumes they occupy within the storage volume).
- Those high-level radwastes, which, due to their dimensions cannot be placed into the tube-wells are stored in lead collection containers located in other rooms. At the present

time 11 exhausted filter cartridges with dimensions of ø 500 x 700 mm (with volume of 0.137 m^3 each) are stored here.

- There changes (decrease) among the data of the Table in comparison with the earlier provided data. The decrease appeared at the time of modification of the record-keeping system. The performed controls reinforce the reliability of the new data.

E) In relation to the quantity of the spent fuel assemblies it shall be mentioned that this figure does not include in quantitative manner the 30 irradiated fuel assemblies which suffered damage during the accident in 2003, since they require special treatment.

The fuel assemblies utilized in non-power-generation aimed reactors differ in all their parameters from the fuel assemblies used in Paks Nuclear Power Plant. Table 2.2.2 provides data on the fuel assemblies ever used, presently used and planned to be used in research and training reactors. It shall be noted that a certain part of the VVR type fuel assemblies are used in batches of three, joined mechanically, while other part of them as single fuel assemblies. For sake of simplicity in relation to all VVR type fuel assemblies for estimation of the heavy metal mass the fuel assemblies coupled in three are recalculated for individual single fuel assemblies.

On site of KFKI AEKI (Atomic Energy Research Institute of the Central Physical Research Institute) the spent fuel assemblies are stored in pools filled with water. There are two such pools available for the Institute, the at-reactor internal spent fuel storage pool and the erected outside of the building external spent fuel storage fuel pool.

The characteristics of the interim storages situated on site of KFKI AEKI, the quantities of the heavy metal stored there for the as-loaded status valid for January 1, 2006 are presented in Table 2.2.3.

With the aim of enhancement of the safety of the interim storage in 2002 the hermetic encapsulation of the spent fuel assemblies was started. The capsules are filled with nitrogen, assuring thus the corrosion protection of the spent fuel assemblies. In a single capsule either one fuel assembly of EK-10 type, or three fuel assemblies of VVR type were placed. The three VVR type fuel assemblies were placed either as one coupled batch of three fuel assemblies or three single ones. In 2004 the encapsulation activities were completed and thus the encapsulation of the fuel assemblies used prior 1986 was performed. The decision about encapsulation of the further spent fuel assemblies will be made by KFKI AEKI later on.

In the external storage pool the spent fuel assemblies earlier were placed without capsulation, while nowadays they are stored partly in encapsulated form, partly without them. This facility is suitable for location of either 752 capsules, or 3 x 752 pieces of VVR type fuel assemblies. From the total capacity 1179 : 3 + 82 = 475 capsule positions were used as per January 1, 2006. This constitutes approximately 63.2 % utilization rate.

The internal storage is suitable for location there of 260 capsules or 260 x 3 pieces of db VVR type fuel assemblies. In accordance with the authority requirements 76 positions or locations for 228 pieces of VVR type fuel assemblies shall be left vacant, ensuring thus the possibility of emergency core removal at any time. Thus, the free capacity of the storage is available for 184 capsules. As per January 1, 2006 there were 323 VVR type fuel assemblies stored in the internal storage, which – rounded up figure – equals to location of 108 capsules, and so the rate of utilization of the storage is roughly 41.5 %.

The bulk incorporating the training reactor of BME NTI (Budapest University of Technical and Economical Sciences, Institute of Nuclear Technology) includes 25 tubes, equipped with appropriate biological shielding, which were designed for location in them spent fuel assemblies, however these tubes never were used for location there and interim storage of irradiated fuel assemblies. There are no spent (or irradiated) fuel assemblies stored on site BME.

2.3. Rate of generation of the radioactive wastes and spent fuel and the anticipated development in the storage

2.3.1. Generation and storage of low and interim level radioactive wastes of nuclear power plant origin, the anticipated changes in the storage capacities and the estimation of the capacity of the new final repository

There are solid and liquid radioactive wastes generated during normal operation of the nuclear power plant. These wastes are temporarily stored in the nuclear power plant – until the final repository will not be completed.

The major part of the solid wastes is stored in 200 liters steel drums, in compacted form. The liquid wastes are collected in tanks. The wastes might be finally disposed only in solid form, and thus the solidification of the liquid wastes takes also place in the nuclear power plant prior their disposal in the final repository. There will be such types of wastes generated during decommissioning of the nuclear power plant as well, which also will have to be ultimately disposed in processed, solid form, together with the operational wastes.

Table 2.3.1.1 provides an overview of the low and interim level radioactive wastes generated in connection with the operation and decommissioning of the nuclear power plant.

The first column of the Table shows the amount of the wastes existing on January 1, 2006, separating from each other the solid and the liquid radioactive wastes. The quantitative data of the first column are also presented in Table 2.2.1 in summarized form. The great size wastes stored on-site of the power plant yet did not place in room VK 302/1, thus the cumulated by January 1, 2006 amount of the great size wastes are not indicated in the Table.

The second column of the Table describes the annual generation rate of the waste quantities originating from normal operation of the nuclear power plant. It can be seen from this that annually 190 m^3 of compacted, solid waste (approx. 950 pieces of 200 liters drums) is generated. The great size solid wastes are also mentioned among the solid wastes. These wastes cannot be (or not reasonable) placed into 200 liters drums. The annual generation rate of this type of waste cannot be realistically predicted. The cesium-filter cartridges belong to the scope of the solid wastes, which are loaded into special, circle-cross-section storage containers, and the dimensions of these cylindrical concrete containers is approximately 0.7 m^3 (diameter and height 1300 mm). A low amount of this type of waste is generated during the overall operational life-time, and thus the annual generation rate is not determined. On annual basis generation of 280 m^3 of liquid waste shall be anticipated, a major part of which (250 m^3/year) is evaporation remains (concentrates), but also among the liquid wastes are recorded the evaporator acid-solutions, the ion-exchanging resins (without transport water), the sludges and the decontamination solutions as well.

The third column of the Table summarizes the extra waste quantities generated as a consequence of the incident in 2003 up to 2007. The wastes generated earlier (before January 1, 2006) as consequence of the incident – since they stored together with the normal operational wastes – are not indicated separately.

The fourth column of the Table summarizes the quantities of the solid and liquid wastes, assuming 30-year-long operation of the nuclear power plant. In this column are separately summarized the volumes of the compacted, the great size and non-compactable wastes and of the storage containers containing the cesium-filter cartridges, assuming 30 years of operational life-time. The remaining life-time, calculated from the average of the operational life of the individual reactor units can be estimated for 9 years. Accordingly by the end of the 30-year operational life-time of the nuclear power plant there will be 3251.4m^3 of compacted waste, suitable for placing into 200 liters drums, approximately 600 m^3 of great size waste, and cesium-filter cartridges requiring only 2.1 m^3 of storage volume. These amounts of solid wastes include as well the wastes generated as a consequence of the incident in 2003. This column provides an overview about the quantities of the liquid wastes as well, generated during the total operational life-time. Within this scope the biggest share is devoted to the concentrates (7381 m^3), however all the other liquid wastes are indicated here extrapolated to the total operational life-time. The volumes of the resins here as well are indicated without the transport waters.

The fifth column of the Table indicates the treatment procedures applied in case of different type low and interim level radwastes. The Table shows, that in case of solid form wastes our Company does not plan any further treatments. In relation to liquid wastes the commissioning of the liquid waste processing (LWP) technology is not anticipated in Paks Nuclear Power Plant. The successful application of this technology would result in less quantity of solid waste to be disposed, however, since the commissioning of the LWP technology did not take place yet, in relation to construction of the now waste repository facility PURAM is using a more conservative approach (generation of greater volumes of waste) of more waste quantities. Since the use of the LWP technology shall not be taken into consideration, in course of the 30 years operational life-time only 3 cesium-filtration cartridges will be generated. It is indicated in this column, what king of treatment (evaporation and/or cementing) shall be taken into consideration in case of different waste types, and what are the characteristic parameters of the different procedures (VR: is the volume reduction factor of evaporation, while in case of cementing – what volume of the given liquid waste will result the given volume of the final product following solidification).

The sixth column of the Table shows only the solid and the solidified waste quantities. In this column are for the first time the decommissioning wastes indicated. The quantities of the wastes which will be generated during decommissioning of the power plant are given in the study indicated in Chapter 6.4. According to the summary related to this column the total amount of the operational and decommissioning wastes of the power plant will be 33751.8 m^3.

The last two columns of the Table shows in what type of waste packages will be disposed the cumulative low and interim level radwaste generated during operation and decommissioning of the nuclear power plant, and what quantities of the different waste packages shall be anticipated. These columns provide a possibility for estimation of the total mining volume of the waste repository.

The data summarized in Table 2.3.1.1 might be used for investigation of possibility of temporary location of the wastes on site of Paks Nuclear Power Plant by the time of construction of the new repository, as well as for estimation of the necessary dimensions of the new storage facility to be constructed.

The tank park extension, performed in Paks Nuclear Power Plant, as well as the commissioning of the LWP technology (see article 2.2) will provide possibility for collection and storage of the liquid wastes by the end of the planned operational life-time of the power plant.

Without commissioning of the LWP technology the capacity of the presently available tank-park will be sufficient until 2012. At the same time this provides also a possibility to perform the solidification, which has a volume increasing effect after commissioning of the final repository.

Concerning solid wastes at the present time the capacity available for the power plant provides possibility for storage of 949 barrels (see Article 2.2). The construction of a new temporary storage capacity – on the site of the nuclear power plant – can only be avoided if in 3rd quarter of 2007 it will be possible to commission in Bátaapáti at least one facility suitable for disposing there minimum 3000 barrels of 200 liters. The power plant will be capable to store the barreled waste on its site by this moment, provided that it will use as well the roof level capacity of the VK302/I storage room as well (see Article 2.2). The schedule related to construction of the Bátaapáti storage facility is given in Article 3.3.2.

The dimensions of the new repository to be constructed are provided in exact manner in investment proposal titled "Final deposition of low and interim level radwastes of nuclear power plant origin in the sub-surface repository planned in region of Bátaapáti" which is in good correlation with the figures provided in Table 2.3.1.1. According to this the operational wastes might be disposed in altogether 2275 m long, 72 m^2 free cross-section chambers, the total volume of which is 163800 m^3. On the other hand the disposal of the decommissioning waste will require construction of a chamber system with length of 2067 m and also of free cross-section of 72 m^2. The total volume of this chamber system will be 148824 m^3.

2.3.2. Generation and interim storage of the nuclear power plant originated high activity level radioactive wastes, , the anticipated changes of the storage capacity, estimation of the necessary storage capacity of the new, final repository to be constructed

During operation of Paks Nuclear Power Plant, according to data provided by the power plant on annual level high level radioactive wastes are generated in relatively small quantities (net 5 m^3/year), which are temporary stored on site of the nuclear power plant in tube pits designed for this purpose. The estimated annual generation quantity data seem to be adequately conservative. (In 2005 there was altogether approximately net 0.7 m^3 of high level radioactive waste generated.) According to Table 2.2.1. on January 1, 2006 there was 63.3 m^3 of waste stored in the storage capacity of 222.8 m^3. By the end of the operational life-time generation (what is taken by our Company at this time as well for 9 years) of further 45 m^3 of waste is anticipated. With the aim of final reposition this waste is collected in containers and filled with concrete. Having on mind that the volume filling of the wastes placed into the tube-wells is extremely poor, the volume of the wastes placed into the containers and prepared for storage is deemed to be equal to the volume occupied by this waste in the tube wells in its present condition.

The dimensions of the wastes, that can be stored here are limited by the geometry of the tube pits. The characteristic dimensions of the storage tube are: diameter 183 mm. height 6880 mm. The wastes, which cannot be placed in the storage pits – due to their great sizes – are collected in lead containers. At the present time there are 11 exhausted filter cartridges are presently stored in such manner, the net volume of each of one is 0.137 m^3. Each single filter cartridge, together with the biological shielding, occupies a space of approximately 0.2 m^3 (net). For the final deposition of one of such filter cartridge, taking into account the 1.75 volume filling factor storage area with volume of 0.35 m^3 shall be created. Thus, the total estimated volume capacity need of all the high level and great-sized radioactive wastes of big dimensions is 3.85 m^3.

In addition, it is anticipated that during the future decommissioning of the nuclear power plant further 247 m^3 of high level radwaste will be generated. This quantity of waste shall be treated in accordance with literature referred to in article 6.4 as gross volume, i.e. the construction of repository with such volume capacity will be necessary for deposition of the high level radwastes originating from decommissioning.

Thus, the necessary capacity of the high level radwaste repository to be constructed in the future for receipt of the high level radwaste of nuclear power plant origin will be 63.3 + 45 + 3.85 + 247 $\approx$ 359 m^3.

Taking into account the rate of generation of the high level radioactive wastes, the issue of the final disposal will have to be solved in accordance with the technical design only during the decommissioning phase, since the available storage capacity can be used as a temporary one until the decommissioning, its capacity meets the needs.

The above mentioned considerations in relation to quantities do not include the amount of the high level radioactive wastes, which will be generated in the future, in quantities, much higher than the usual, due to the liquidation of the consequences of the accident on Unit 2, since in this respect the actual data will be available for our Company only after removal of the damaged fuel assemblies.

2.3.3. Generation and interim storage of the spent nuclear fuel in the nuclear power plant

The interim storage of the spent nuclear fuel is carried out in the ISFS erected in the vicinity of the nuclear power plant, for a period of 50 years. The quantity of the spent fuel assemblies generated during the normal operation of the nuclear power plant is well predictable.

According to our present knowledge the number of the spent nuclear fuel assemblies that will be generated by the end of the designed 30-year-long life-time of the nuclear power plant and which will remain in Hungary will be 11122. The average annual quantity generated during normal operation is 372 fuel assemblies. The total amount, not taking into account the possibility of back-shipment to Russia, includes the following portions:

2117 assemblies	in the cooling ponds (January 1, 2006), see Table 2.2.1
4267 assemblies	in the ISFS (January 1, 2006), see Table 2.2.1
4738 assemblies	spent fuel assemblies to be generated between 2006 and 2017 including the full core removal due to the final shut-down of the units.

This total of 11 122 fuel assemblies can be disposed and temporarily stored by means of appropriate expansion of the ISFS.

According to the data provided by Paks NPP Ltd., the total amount of the spent fuel assemblies – from the point of view of the procurement source – is of Russian origin. The average mass of heavy metal in the individual assemblies - calculated on the basis of the whole amount of spent fuel is 116 kgU per assembly, and thus the amount of the spent fuel to be generated by the end of the life-time will amount altogether 1 290 152 kgU (i.e. 1290.152 tU) heavy metal or uranium content.

2.3.4. Rate of generation and disposal of the low and interim activity level as of the long life-time radioactive wastes of non nuclear power plant origin

Besides the operating nuclear power plant radioactive wastes are generated in research institutes, in medical, industrial, agricultural institutions and laboratories. The generation rate of the non - nuclear power plant origin low and interim level radioactive wastes has increased to 20-30 m^3/year during the past years. This waste is disposed in the RWPS in Püspökszilágy. As it is given in Table 2.2.1., the presently available free capacity in the RWPS has exhausted. By the time of completion of the capacity relief to be carried out on the final repository area a solution might be granted by the interim storage area to be created by means of modification of the processing building, where there is a possibility for temporary storage of 800 pieces of 200 liters drums. (The details are given in Chapters 3.1. and 3.2.)

In Hungary the performance of the industrial, agricultural and medical activities, on annual level, leads to generation of extremely small amount of long-life radioactive wastes. Presently these wastes are stored on site of RWPS, or they can be found at the location of their generation. Today it is not possible to provide correct annual data relevant to the generation of these material types, however we deem – based on conservative upper estimation – that the overall quantity of the long-life radioactive waste in summary will not exceed the amount of 100 m^3. These types of materials will have to be disposed together with the nuclear power plant origin high level and long-life radioactive wastes, and thus the total amount of the wastes to be disposed shall be increased by this 100 m^3.

2.3.5. Generation and interim storage of the spent fuel of non nuclear power plant origin

The research reactor of KFKI AEKI – the Budapest Research Reactor (hereinafter BRR) – is operating since 1959. Following the reconstruction started in 1986 the reactor is again in operation since 1992. The operating license issued in 1993 for undetermined period of time shall be renewed in every tenth year within the framework of periodical safety review. The first review took place in 2003.

According to data provision of KFKI the planned operational life-time of the reactor is 30 years from the date of the reconstruction, thus, according to the plans the reactor will be finally shut down in 2023. According to data provision of KFKI annually – depending on the utilized operational time – in average 70 (VVR type) fuel assemblies are replaced.

On January 1, 2006 KFKI AEKI was in possession of 441 pieces of fresh VVR type fuel assemblies (415 pieces of VVR-M2 type and 26 pieces of VVR-SzM type). The enrichment level of theses fuel assemblies is 36 %. Following the worldwide valid tendencies the KFKI AEKI is also planning introduction of new fuel types. The new VVR-M2 type fuel assemblies with enrichment level of 20% latest might be introduced when the available today fresh fuel assemblies will be utilized (this is anticipated in 2010). In principle it is possible to introduce the new fuel assembly type earlier as well.

Based on the data provision of KFKI the amount of the generated by now and to be generated in the future spent fuel assemblies in BRR by the end of the operational life-time is shown in Table 2.3.5.1. Within the Table the quantities of the spent fuel assemblies to be generated in the future are presented in two phases. The first period (supposing that the change of the fuel assembly type will take place after utilization of the presently available fresh fuel assemblies) lasts from 2005 until 2010. While the second period covers the remaining after 2010 operational life-time.

It can be seen from the Table that the introduction of the fuel assembly type with lower enrichment level will significantly increase the amount of the heavy metal, which will be generated. The Institute has no such storage capacity, which would allow the location there of the spent fuel assemblies to be generated by the end of the planned operational life-time, since the total storage capacity is 936 places, while the required amount would be 1072 places.

In the training reactor of BME NTI there are 24 pieces of partially modified EK-10 type fuel assemblies are operated since 1971. The nominal heavy metal mass of these fuel assemblies was 30 kg, from which by now approximately 0.02 kg of U-235 was utilized. Due to technological reasons it is possible that during the operation of the training reactor, planned until 2027 the active core will be partly or fully reloaded. According to data provision of BME NTI this reload should have taken place latest by 2008, and this is justified primarily by the decreasing reactivity margin. Thus, in total spent fuel with heavy metal mass of 59.96 kg shall be anticipated for the total period of operation. These data are summarized in Table 2.3.5.2.

By the end of the planned operational life-time of the two institutes there will be spent fuel with $490.3 + 59.96 \approx 550.3$ kg U quantity generated. The accumulated storage need – providing that the fuel of BME NTI will be also encapsulated - will require deposition of $1072 + 48 = 1120$ capsules.

3. Final disposal of the low and interim level radioactive wastes

3.1. Precedents

Radioactive wastes appeared simultaneously with the introduction of use of the isotope technology in Hungary. These wastes were initially stored on site of the Central Research Institute of Physics, leading organization in utilization of the said technologies. By 1960, an experimental isotope repository was constructed in Solymár. The complete facility was taken over from the Hungarian Atomic Energy Committee by the Budapest branch of the State Public Health and Epidemology Office in 1960. Accordingly, the national collection of the radioactive wastes was started in 1960. At the same time the rules regulating this activity were made (Governmental order no. 10/1964 (V.7.), and its execution order the EÜM order No. 1/1964 (V.7.).

The site selection of the first, experimental radioactive waste repository facility was not adequately founded and the technical solutions of the facility (pits lined with concrete rings) were not perfect either. The capacity of the experimental repository was shortly exhausted as well, and so ten years after the construction in January 1970 the Executive Committee of the Budapest Council and the Budapest branch of the State Public Health and Epidemology Office were entrusted by the decision of the Hungarian Atomic Energy Committee for the construction of a new radioactive waste repository (RWPS).

The new facility was completed in Püspökszilágy by December 22, 1976, with capacity of 3540 m^3. From technical point of view the repository was of a near surface pool and tube pit formation.

The fist transport to the RWPS was received in March 1977. The Ministry of Healthcare issued the final operational license for the facility in 1980. Having no contradictory resolution, the RWPS has taken over almost all kind of radioactive waste generated in course of utilization of the nuclear technology. The only exceptions are the sealed radium sources, other exhausted radiation sources including fissile materials as well, and certain parts of products, which were and are stored temporarily in other locations.

The commissioning of the first reactor of Paks Nuclear Power Plant has multiplied on annual level the quantity of the generated low and interim level radioactive wastes. According to the concept described in the Technical design of Paks Nuclear Power Plant the storage, in the auxiliary buildings of the nuclear power plant, of the low and interim level radioactive wastes generated during the operation of the power plant was foreseen. However the temporary character of the storage shall be emphasized, since the final disposal of the wastes on the site of the nuclear power plant is excluded taking into account technical and safety aspects.

It was an obvious idea that it would be adequate to dispose finally the wastes generated as a result of the operation and decommissioning of Paks Nuclear Power Plant in Püspökszilágy, since the only facility of Hungary designated for disposal of low and interim level radioactive wastes operated here.

According to the various investigations carried out earlier and taking into account the near surface solution used on site of RWPS the expansion corresponding to the needs of Paks Nuclear Power Plant was not feasible. An other argument against the disposal of the Paks' waste in Püspökszilágy was the long and consequently hazardous transportation route.

So the low level solid radioactive wastes of Paks Nuclear Power Plant were transported to Püspökszilágy only as temporary solution. During this activity between 1983 and 1989 the nuclear power plant has used 1230 m^3 by transporting there 854 m^3 of waste of the capacity of RWPS.

Simultaneously the Paks Nuclear Power Plant has made efforts to solve the issue of disposal of the power plant origin low and interim level radioactive wastes in an individual repository. These efforts spectacularly failed in January 1990, when an ultimate negative decision was made in relation to the planned repository nearby Ófalu, because of the reluctance of the inhabitants.

From 1990 to 1991 the transportation of the low and interim level radioactive wastes to the RWPS was suspended due to public resistance. At the same time the storage capacity of the Püspökszilágy RWPS was expanded with the financial support of Paks Nuclear Power Plant. The expanded storage capacity of the facility is in a total of 5040 m^3. During the licensing procedure related to the expansion the Hungarian Geological Service has questioned the suitability of the site, and consequently in the future only temporary operational licenses were issued for the expanded part, altogether four times.

After stop of the public protest further low and interim level radioactive wastes were transferred to Püspökszilágy in period between 1992 and 1996, so altogether there is some 1580 m^3 nuclear power plant origin waste was disposed in approximately 2500 m^3 of storage capacity.

The efforts made during the past years in relation to the RWPS were oriented on prolongation of the operational license of the facility by the authorities. With this aim in mind the reconstruction of the facilities of the RWPS was started. The work has started with the full scope evaluation of the safety of the waste repository. Following the necessary data collection in 2001 and 2002 two safety analysis were prepared. The analyses seek the response, whether by means of what kind of corrective actions would guarantee the long-term safety. The updated safety analysis prepared in 2002 has reinforced the former evaluations, and based on this it can be stated that the operation of the RWPS and the safety of the environment are appropriately guaranteed till the end of the institutional supervision period. The actions necessary for assurance of the long-term safety were determined on the basis of the updated safety analysis, and this served also as a basis for the document, titled "Safety upgrading program of the Püspökszilágy RWPS 2002 – 2005" approved by the minister disposing over the Fund on August 29, 2002. Within the framework of these activities were oriented to preparation and starting of the safety enhancement measures. The successful completion of the safety enhancement measures will contribute to the assurance of further waste disposal capacities as well.

In order to obtain the operational license the radiation protection conditions and the physical condition of the site shall be improved. The waste take-over criteria were developed and implemented. Based of the above written and of the here non listed reconstruction works the competent authority has issued the operational license, the new license is valid until February 28, 2015. As a preparation for the safety upgrading measures were prepared the above mentioned safety analysis as well as the feasibility study outlining the plans of the activities. Based on them, in order to start the activities it was necessary to purchase a compacting press and a hot-chamber. Here can be mentioned the reconstruction of the operational building and its licensing as a temporary (for 5 years) repository, the recovery of the vicinity of the pool-lines No. III and IV renewal of the precipitation drainage system. The investigation of the origin of the increased tritium activity, which was noticed in the monitoring pits during the past few years and the execution of the additional geological investigations also might be deemed as preparation of the safety upgrading measures.

In 2005 was prepared a document titled "Safety upgrading program of the Püspökszilágy RWPS, 2nd phase (2006-2010)" which was approved by the Minister disposing over the Fund on December 21, 2005, determining thus the further reconstruction tasks for the site. For supervision of the reconstruction tasks, as well as for promotion of the operation of the site with multiple technical systems it will be necessary to contract a general-designer office beginning from 2007.

Since such an expansion of the Püspökszilágy facility that would satisfy the total need of the nuclear power plant is impossible, beginning from 1993 an Interdepartmental Target Project (later on National Project) has been launched. The main purpose of it was the solution of the issue of final disposal of the nuclear power plant origin low and interim level radioactive wastes. Within the framework of the said project the preparation of the site selection was started. On the basis of the professional literature data the whole country has been screened, and later on in the promising areas, where the public supported it as well, preliminary site explorations were carried out in order to identify the geological objects suitable for surface and near surface repository.

In 1996 the final document of the geological, safety technical and economical investigations proposed to carry out further explorations in the vicinity of Üveghuta for near surface disposal in granite, keeping in reserve the sites that seemed to be suitable for construction of surface repositories. This area is deemed to be favorable from that point of view as well that it is located not far away from the nuclear power plant on the same side of Danube river. Consequently a decision was made in agreement of HAEC to start the more detailed explorations in 1997 in the Üveghuta region.

At the end of 1998, in its final report on the geological investigations carried out in 1997-1998 the Hungarian State Geological Institute (MÁFI) made a recommendation to start the detailed geological and site characterizing works founding the licensing procedure and the construction in the Üveghuta research area. The experts supervising the program suggested the acceptance of the final investigation report.

At this point the program got into the focus of the professional and political debates. Due to it the experts of the International Atomic Energy Agency, upon request of HAEC have reviewed the activities carried out within the framework of the program, and agreeing with the results gained by that time they have suggested the continuation the explorations.

The Hungarian Geological Service has also evaluated the explorations performed, and agreed with them. Safety assessments relying on the results of explorations verified that the repository could be operated in a safe way at the given site.

Based on the facts above, the Minister supervising the CNFF in May, 2001 signed the four – year exploration program. Preparations of the contracts referring to the explorations were conducted within the framework of a public procurement process. In December 2001, the BÁTATOM Ltd. was established aiming to implement the program, by holding together the most excellent institutions in Hungary (ETV – Erőterv Ltd., Mecsekérc Environment Protection Ltd., Golder Associates Hungary Ltd.) and with the support of the Hungarian State Geological Institute, as subcontractor. During year 2002 the BÁTATOM Ltd. along with preparatory works necessary for the investigations has prepared the geological research plan. On the basis of the licensed plan there was a final report prepared on the performed geological investigations at the end of 2003, the main statements of which were the followings: „The Bátaapáti (Üveghuta) site complies with all the requirements set forth in the order, and thus, from geological point of view it is suitable for final disposal of low and interim level radioactive wastes.” This document was evaluated by the competent geological authority, the South-Transdanubian Regional Office of the Hungarian Geological Service, and has accepted it by means of a resolution. Since within the appealing time-period there were no objections raised against the resolution, it became legally valid at the end of 2003.

In 2004 was prepared the valid until 2007 underground research plan, which was opinionated, and afterwards approved by the South-Transdanubian Regional Office of the Hungarian Geological Service. In case of execution of this research plan it will be possible to determine in second half of 2007 that rock-volume, which will host the repository. The minister managing the Fund has approved this research program in late 2004, while the executor of the program will be selected on the basis of public procurement procedure.

The underground researches were started in February 2005 by deepening of the inclining shafts. By the end of the year length of both shafts exceeded 330 m and the first connection corridor was also prepared.

In parallel with the underground researches was prepared the Preliminary Environmental Impact Study of the repository, which was submitted to the competent authority, to the Mid-Transdanubian Environmental Protection, Nature Protection and Water Authority.

Two further important events took place in 2005. Upon initiative of municipality of Bátaapáti an opinion expressing public poll was held in the town. Along with high (75%) participation nearly 90.7% of the people voting agreed with construction of a low and interim level radwaste repository in Bátaapáti. On November 21, 2005 the Hungarian Parliament, based on Paragraph (2) of Article 7 of the Nuclear Act granted a preliminary, principal approval for beginning of preparatory activities for low and interim level radwaste repository on the territory which has been already earlier qualified as suitable from geological point of view. The resolution of the Parliament was supported by overwhelming majority of the MPs present (339 persons, 96,6%).

On the basis of the above described precedents the development of the strategy concerning the final disposal of the low and interim level radioactive wastes, the tasks and their scheduling shall be divided to the Püspökszilágy RWPS and to the new facility that will host the nuclear power plant origin wastes.

3.2. Disposal of the low and interim activity level radioactive wastes in the RWPS

3.2.1. The strategic target

Having in mind that the Püspökszilágy RWPS is operating only on the basis of temporary operating licenses, the upgrading of this facility that goes on since 1998 and the state-of-art safety analysis that will serve as basis for the prolongation and finalization of the operational license are of outstanding importance.

The possibilities for freeing storage locations within the storage pools shall be investigated, taking into account the legal, technical economical and public acceptance aspects. Every such possibility shall be analyzed that might result in such a free storage capacity which could solve in long term the receipt of the radioactive wastes of the Hungarian isotope users on the said site.

In relation to PURAM the target is the continuous operation. In the future the RWPS will serve exclusively for final disposal of non-nuclear power plant origin low and interim level radioactive wastes. The storage of the long-life wastes will be solved in the RWPS only temporarily. The performance of the tasks in relation to disposal of the low and interim level radwastes will be possible by occurring free storage capacities in the future, thus this is deemed to be a priority target.

3.2.2. Scheduling of the tasks

2007

- Testing of the waste packages, certification of the appropriateness of the waste forms.
- Renewal of the asphalted roads and illumination system.
- Upgrading of the dispatching center, erection of a check-point, creation of negotiation and storage rooms.
- Beginning of reconstruction of the sewage water purification system and demolishing of the old system, procurement of an environmental sampling vehicle.
- Execution of the first (demonstration) phase of the capacity-release (safety enhancement) in four pools (A11, 12, 13, 14), summary of the experiences of the 1st phase, preparation of the 2nd phase.
- Operation and maintenance of the facility.

2008-2010	-	Reconstruction of the outer fence, landscape correction between the two fences.
	-	Completion of the reconstruction of the sewage water purification system.
	-	Licensing and execution of the 2nd phase of the capacity-release (safety enhancement) (in pools 20-24).
	-	Recovery of the vicinity of pool rows I-II.
	-	Operation and maintenance of the facility.
2011–2047	-	Operation and maintenance of the facility.
2048–2050	-	Termination of the facility operations, delivery of the long life radioactive wastes stored in the facility to the storage of the long life radioactive wastes.
2051–2101	-	Guarded supervision of the facility and radiation protection surveillance of the vicinity (active institutional supervision).
from 2101	-	Continuation of the active institutional supervision (if the regulatory authority requires so)
	-	Long term, passive institutional supervision.

3.2.3. Source data and information for the execution of the economical calculations

Financial implications of the tasks as due between 2007 – 2010 are determined in document titled *”Safety upgrading program of the Püspökszilágyi RWPS 2nd Phase (2006-2010)*” .

Concerning the guarded supervision of the facility and the health physics surveillance of the environment, as well as of the closure of the facility, the guiding document is *the study of ETV-ERŐTERV, 1995, Paks Nuclear Power Plant, Units 1-4, “Final disposal of the low and interim level radioactive wastes – Site independent cost estimation comparison”.*

A periodically repetitive data is the operational cost of the facility what is described in details under chapter 7. This component includes for period from 2048 to 2050, divided for three years, the cost of conditioning of the long-living wastes stored in the facility, based on technical estimation.

The institutional surveillance following the closure of the waste repository includes the active and the passive supervision of the facility and the preservation of the facility related data. The related to these costs are indicated in connection with the year of closure of the facility based on technical estimation.

The operation of the Püspökszilágy repository is depending on the project of the high level and long life-time radioactive waste repository, since the earliest date of closure of the facility is determined by the fact when the other facility will be commissioned where the long life-time radioactive waste temporarily stored in Püspökszilágy could be transferred there. By means of capacity relief in the Püspökszilágy repository there is a realistic chance for such prolongation of the operational life-time.

3.3. Disposal of the nuclear power plant origin low and interim activity level radioactive wastes

3.3.1. The strategic target

The final disposal of low and interim level radioactive wastes of nuclear power plant origin – including as well the wastes originating from the decommissioning of the nuclear power plant – shall take place in a new facility satisfying all the technical and safety aspects. With this aim in mind the investigations shall be continued for determination of the exact location of the repository.

The design, rating and time schedule of the construction and operation shall be adjusted to the requirements of Paks Nuclear Power Plant, however on design level the possibility of expansion shall be taken into account as well.

3.3.2. Scheduling of the tasks

In case of scheduling of the tasks it shall be mentioned, that the licensing procedures will be completed earlier (in 2006) than it was stated in the former plans. Our Company assumes that the construction license for the repository will be issued at the end of 2006. These modifications are necessary in order to be able to construct the surface facilities in 4th quarter of 2007 (see Chapter 2.3.1).

2007	- Completion of preparation of the tendering documentation related to the surface facilities, execution of the public procurement procedure, entering into contracts. - Construction of the surface facilities in such a scope, that provides possibility for receipt of solid waste packed into 3000 pieces of 200 liters barrels in 4th quarter of 2007; commissioning of the technological building. - Beginning of preparation of the tendering documentation related to the underground facilities and launching of the tendering process. - Construction of the underground facilities by completion of the transportation tunnel of the storage area and beginning of construction of storage chambers 1-4. - Completion of the underground exploration. - Geological final report. - Safety evaluation. - Construction of public works. - Monitoring operation. - Preparation of construction designs.
2008	- Completion of the public procurement procedure related to the underground facilities. - Completion of the construction of storage chambers 1-4. - Operational tests and beginning of the commissioning. - Obtaining of the operational licenses. - Beginning of the construction of storage chambers 5-18. - Operation of the facility (transfer of the operational wastes). - Monitoring operation.
2009-2013	- International peer-review. - Completion of the construction of storage chambers 5-18. - Commissioning of storage chambers 5-18. - Operation of the facility (transfer of the operational wastes). - Monitoring operation.
2014-2019	- Operation of the facility (transfer of the operational wastes). - Monitoring operation.

2020–2094	-	Decay period, condition maintenance.
2093–2094	-	Expansion of the facility.
2095–2104	-	Operation of the facility (transfer of the operational wastes).
2105–2107	-	Closure of the facility.
from 2108	-	Long term supervision.

A precondition of the strategic target and of completion of the listed activities by the set deadline is as well the availability of the necessary financial resources.

3.3.3. Source data and information for the execution of the economical calculations

The estimation of the costs related to tasks of construction of a facility suitable for disposal of low and interim level radioactive wastes is based on the costs provided in document titled: *„Final deposition of low and interim level nuclear power plant origin wastes in the underground repository planned to be constructed in vicinity of Bátaapáti; INVESTMENT PROPOSAL"*

The quantity of the waste to be disposed is constituted from the low and interim level conditioned radioactive wastes generated during operation and decommissioning of the nuclear power plant. The inland enterprising transportation cost in relation to low and intermediate level radioactive wastes has been determined as 30 000 HUF/m^3.

A certain part of the quantitative data is refreshed annually. This data reflect the waste generation facts resulting from the operation of the Paks Nuclear Power Plant and the results of the developments of the radioactive waste management technology. The quantitative data is deterministically influenced by the low and interim level radioactive waste amount resulting from the decommissioning of the power plant. The review of this data will be carried out in accordance with processes described under chapter 6.

The review of the transportation cost data might take place if the estimations published in the international literature would significantly change or if there will be Hungarian data available.

The institutional surveillance following the closure of the waste repository includes the active and the passive supervision of the facility and the preservation of the facility related data. The related to these costs are indicated in connection with the year of closure of the facility based on technical estimation.

The technology and scheduling of decommissioning of the nuclear power plant will deterministically influence the expansion, operation and closure of the low and interim level radioactive waste repository.

4. Final disposal of the high activity radioactive wastes and management of the spent nuclear fuel

4.1. Precedents

Such types of waste were generated in Hungary beginning from the 60-s, however they were due to lack of other (prohibiting) regulations stored in Püspökszilágy, while the spent fuel assemblies of the research reactor in the Central Research Institute of Physics.

The issue of the high level radioactive wastes is treated in the same chapter as the plans of the spent fuel management, since the realistically feasible scenarios of the fuel cycle will lead to disposal of the high level radioactive wastes.

4.1.1. Final disposal of the high activity radioactive wastes

The commissioning of Paks Nuclear Power Plant has created a new situation since it became evident that the operation and decommissioning of the nuclear power plant will significantly contribute to the source term of the Hungarian high level radioactive wastes. It has been obvious from the very beginning that all the problems in the management of that type of waste will have to be solved by Hungary on its own, independently of the fact how will be solved the issue of the spent fuel management, which, form professional point of view, can be enrolled to the same category.

The National Project launched in 1993 (see chapter 3) beyond dealing with solution of the safe disposal of the low and interim level radioactive wastes, in relation to high level radioactive wastes has been expanded upon initiative of IKIM (Ministry of Industry, Trade and Tourism) with the task of continuation of the earlier started investigations of the Boda Aleurolit Formation (BAF). This activity has been completed in March 1995, and so an independent program has been launched for solution of disposal of the Hungarian high level and long life-time radioactive wastes, which has been approved by HAEC on its meeting in November 1995. This program has already outlined long term ideas, however it was focusing on the in-situ investigations due in 1996-98, which was carried out by the Canadian AECL and the Mecsek Ore Mining Company in the area of BAF at 1100 m depth, with the purpose of detailed investigation of the formation. A time limitation for the three-year-program was that the closure of the mine was forecasted for 1998 that time, so it was the time period during which the existing infrastructure could be economically utilized.

On this basis the explorations were completed in the end of 1998 in a documented form. According to the final report there were no such circumstances revealed that could prevent the construction of a facility serving as repository for long life-time and high level radioactive wastes in the BAF. Upon effect of the results of the final report a recommendation was made for construction of an underground research base, for qualification of BAF and for further researches. This recommendation was discussed on April 1999 meeting of HAEC. The minister of economy made the relevant decision in summer 1999, rejecting the proposal. At the same time decision was made on closure of the uranium mine in accordance with the original plan.

The PURAM has prepared a research program for investigation of a site suitable for disposal of the Hungarian high level and long-life radioactive wastes. The Minister, managing the Fund, has accepted the program in 2003. In accordance with that a vendor has been selected on the basis of a public procurement tender, with whom a frame-contract was signed for the execution of the research program. The works were started in 2003. Since that time the content of the contract is annually updated. The works are aimed on selection of the location for a new underground research laboratory.

Within the framework of this program in 2004 geological and geophysical mapping, shallow and deep boring researches took place as well as theoretical-methodological developments. The boring Ib-4 was deepened up to 710 meters in 2005 as a basic boring of the research plan. Due to significantly decreased financial resources in 2005 the works, except the activities related to Ib-4 boring were limited to surface geological investigation, documentation of the sites data-base filling and area-informatics, as well to environmental monitoring. The environmental monitoring was also continuously operated.

4.1.2. Management of the spent nuclear fuel

Following commissioning of Paks Nuclear Power Plant the burning of the nuclear fuel has started. Afterwards the spent fuel assemblies were discharged from the reactors to the next to the reactors cooling pools.

In accordance with a concept in force at the time of acceptance of the Technical Design of the Paks Nuclear Power Plant the spent fuel assemblies cooled in the cooling pools of the power plant for 3 years should have been taken back by the Soviet Union free of charge. According to this concept the spent fuel was to be reprocessed in the Soviet Union, however all the end products of reprocessing would have remain in the Soviet Union. In other words the Soviet partner has offered a world unique service to the constructor of the nuclear power plant, since the commercial reprocessing procedures already operating at that time have foreseen the back-shipment of the end products (uranium, plutonium, low, interim and high level conditioned radioactive wastes) to the country of origin of the spent fuel. At the same time, making use of the Soviet back-shipment service meant, that Hungary adopted the closed fuel cycle option with a special background service, in relation to closure (back-end) of the nuclear fuel cycle.

After the commissioning of the first unit of the power plant the back-shipment conditions were unilaterally modified by the Soviet Union. According to this modification the necessary cooling time was increased to five years, and a more and more increasing compensation was requested for the receipt of the back-shipments, considered as a service.

Paks Nuclear Power Plant Ltd. in order to meet the new requirements has doubled the storage capacity of the cooling pools, by compacting the storage racks, while the back-shipments were carried out on the basis of commercial contracts. During the period between 1989 and 1998, 2331 spent fuel assemblies were shipped back to the Soviet Union (later to Russia).

In the first years of back-shipments, due to the political and economical changes that took place in Europe and in the Soviet Union it became clear that the practice of back-shipment of the spent fuel assemblies cannot be maintained for a long time under the above described conditions. In September 1991 a decision was made in a meeting of HAEC that in parallel with maintaining of the possibility of the back-shipment of the spent fuel assemblies to the Soviet Union a realistic domestic alternative has to be elaborated. In order to promote this it was necessary to obtain license for a facility for interim storage of irradiated fuels (ISFS) to be erected on the site of Paks Nuclear Power Plant, which could be quickly constructed in case of necessity.

A year later, in November 1992, a decision was made in a meeting of HAEC that the concrete preparation related to the construction of ISFS shall be started. The HAEC acknowledged that the MVDS (Modular Vault Dry Storage) system of GEC Alsthom was selected as ISFS by the experts of the nuclear power plant.

In December 1993, the construction, licensing and commissioning of ISFS was treated as a high priority task in the meeting of HAEC. Paks Nuclear Power Plant financed the construction of ISFS. The design, licensing and construction lasted from 1992 to the end of 1996. On February 1997 meeting of HAEC the commissioning of ISFS has been approved. The loading of the ISFS has started already in 1997.

The first three vaults of ISFS were loaded with spent fuel by the end of 1999 and the next four vaults were constructed. The loading to the new vaults was started in February 2000, and PURAM took over the role of licensee in relation to the facility. The third phase, i.e. the 8th - 11th modules were constructed by the end of 2002, and in 2003 the commissioning of the new vaults took place, and afterwards they were taken into operation. The investment program in relation to the further extension as well as the relevant licensing design documentation has been prepared. Since the original licenses were issued for 1st – 11th modules, for further extension the initiation of a new licensing procedure became necessary. Based on the licensing designs the modification of the environmental protection and site licenses of the 2nd phase of ISFS took place. The competent authority has issued the erection and construction licenses related to 2nd phase of the ISFS (modules 12-16). Having the valid licenses and following the successful tendering procedure in 2005 the construction activities of 2nd phase of the ISFS was started.

The HAEC has on its agenda the issue of the nuclear fuel cycle strategy on its meeting in March 1999. The ideas related to the cycle back-end reflected the situation that have developed by that time. In accordance with this the spent fuel assemblies would be loaded to the ISFS for 50 years, and so the decision concerning their ultimate management can be postponed, however it is reasonable to make an overall preparation plan for justification of the decision to be made in relation to back-end.

Under the umbrella of preparation for the closure of the nuclear fuel cycle in 2001 a document entitled "*Determination and evaluation of handling strategies for spent fuel and high level radioactive wastes, establishing a working program and time schedule*" was accomplished, that was evaluated by the ENRESA, a brother-organization of PURAM from Spain. According to the decision of the Hungarian Parliament, in no further expedient works were performed in 2001 – 2002 because of privation of the resources. In 2003 a study-plan was prepared, which determined the activities necessary for the evaluation of the potential strategies. On the basis of this the development of the strategy itself will be the task of the coming years.

In 2003 the representatives of the Hungarian and Russian Governments have re-started the negotiations aimed for back-shipment of the spent nuclear fuel to Russia, which were oriented to the reconsideration of the former inter-governmental protocol, which has existed between the two countries. Finally, such an agreement was concluded on April 29, 2004, which might constitute a legal basis for Hungary for back-shipment of the spent fuel assemblies to Russia even after our joining to the European Union.

4.1.3. Management of the non-nuclear power plant origin spent nuclear fuel

As it was shown in Chapter 2.3.5. the issue of the spent fuel assemblies generated in the research reactor (BRR) operated in KFKI AEKI and in the training reactor of BME NTI is still waiting for solution.

According to the data provision from KFKI the back-shipment of the first part of the spent fuel to Russia will be likely solved between 2007 and 2011. For the interim storage of the further spent fuel assemblies which will be generated by the end of the life-time of the BRR there will be sufficient capacity released and be available taking into account the back-shipment to Russia.

In the case if the back-shipment to Russia still would not take place, then the justification and execution of deposition in Hungary will become necessary.

In the coming years – following the completion of the planned back-shipment activities to Russia – the future back-shipment of the spent fuel assemblies generated in the future in Hungary and remaining here following the first back-shipment, or their final deposition in Hungary will have to be prepared and executed.

In relation to BME NTI the technology of transportation of the spent fuel assemblies from the building shall be elaborated. It would be reasonable to ship back the irradiated fuel assemblies which will be removed from the reactor to Russia together with the spent fuel assemblies of KFKI. If the back-shipment to Russia would not take place it would be reasonable to encapsulate the spent fuel assemblies utilizing the encapsulation technology of KFKI AEKI, and to move them to the interim storage in such a form. In order to be able to store temporarily the irradiated fuel assemblies, which will be removed from the core as a consequence of the reload it will be necessary to design and to license the procedure. Thus, it would be possible to handle in the future the irradiated fuel assemblies of BME NTI together with the spent fuel assemblies of KFKI AEKI. For the time being there is no decision or agreement concerning the storage.

4.2. The strategic target

In order to dispose the high level radioactive wastes it is necessary to get prepared for construction on territory of the country of a stable repository made in the deep geological formation. According to the uniform international standpoint such a repository can be used as well for direct disposal of the spent fuel, or for disposal of the reprocessing wastes of the spent fuel. As a reference scenario the postulation of direct disposal of the spent fuel assemblies is fully acceptable option for the nuclear fuel cycle back-end.

Having a technical solution selected for reference scenario from more conceivable alternatives, it means that the process is feasible, its implementation has a high probability, and therefore it is reasonable to build the economical calculations upon the chosen alternative.

This is confirmed as well by the internationally accepted analyses, which by analyzing the costs of the direct disposal and the reprocessing consider the direct disposal to be a more economical option.

However, it is obvious that the activities related to the elaboration of the final fuel-cycle back-end strategy cannot be avoided. During development of the strategy the finalization of the reference scenario or its potential review can take place.

4.3. Scheduling the tasks

2007
- Surface exploration of the BAF area; aiming to implement a new underground laboratory, 1st phase. Completion of the location qualification investigation program.
- Continuous monitoring of the research area.
- Preparation of justification for transportation and encapsulation of the irradiated fuel of BME NTI.

2008
- Surface exploration of the BAF area; aiming to implement a new underground laboratory, 1st phase. Completion of the surface investigations, final location determination of the research laboratory. Preparation of the geological research final report of the location evaluation research program and its licensing by the

	regulatory authority.
	- Preparation and approval of the quality assurance plans.
	- Continuous monitoring of the research area.
	- Justification of the temporary storage of the spent fuel assemblies from the research and training reactors in Hungary.
2008-2011	- Back-shipment of the spent fuel assemblies of KFKI (potentially of BME) to Russia (1st shipment).
2009	- Summarization of the information with the aim of development of the national strategy.
	- Surface exploration of the BAF area; aiming to implement a new underground laboratory, 2nd phase. Preparation of the detailed research plan of the potential site, its licensing with the authorities.
	- Continuous monitoring of the research area.
	- Preparation of Safety Analysis.
	- Preparation of the Preliminary Investigation Document and its licensing by the regulatory authority.
	- Preparation of the lay-out design, of the technical designs and licensing documentation.
2010-2016	- Surface exploration of the BAF area; aiming to implement a new underground laboratory, 2nd phase. Execution of the detailed research program of the potential site. Completion of the detailed research program of the potential site. Preparation of the geological research final report for the potential site.
	- Obtaining of the regulatory authority licenses and co-authority approvals.
	- Compilation and approval of the strategy.
	- Continuous monitoring of the research area.
	- Preparation of Safety Analysis.
	- International peer-review.
	- Beginning of construction of the research laboratory.
	- Elaboration of the research plan.
2017–2032	- Construction of the research laboratory.
	- Accomplishment of the research/exploration program and preparation of the investment.
	- Preparation of the Safety Analysis.
2027-2028	- Back-shipment of the spent fuel assemblies of KFKI (potentially of BME) to Russia (2nd shipment).
2033–2046	- Construction of the repository for the high level radioactive wastes.
2047–2069	- First phase of operation of the repository for the high level radioactive wastes.
	- Transfer of the spent fuel assemblies stored in ISFS to the new facility.
2047	- Transfer of the long life-time radioactive wastes temporary stored in Püspökszilágy to the new facility.
2070–2094	- Operation of the high level radioactive waste repository, waiting for transfer of the decommissioning wastes.
2093–2094	- Expansion of the capacity of the high level radioactive waste repository for receipt of the decommissioning wastes.
2095–2104	- Second phase of operation of the repository for the high level radioactive wastes.
	- Transfer and deposition to the repositories of the decommissioning

		wastes of Paks Nuclear Power Plant.
2105–2108	-	Closure of the repository for the high level radioactive wastes.
from 2108	-	Long term institutional surveillance.

Note: The above described schedule in relation to the non nuclear power plant origin fuel indicate only the activities related to back-shipment to Russia.

4.4. Source data and information for the execution of the economical calculations

4.4.1. Spent fuel from the nuclear power plant

The cost of the disposal of the nuclear power plant origin and other spent fuel assemblies, as well as of the high level radwaste might be calculated on the basis of document marked TS(R)/6/25 and titled„*Concept design and cost estimation of the deep geological waste repository aimed for final disposal of the Hungarian high level and long-living radwastes, as well as of the spent nuclear fuel assemblies".*

The concept plan provides possibility for separated determination of costs of final deposition in Hungary of the non nuclear power plant origin spent fuel assemblies. These costs are shown in Table 8.4.1.

The input data for the costs of the final deposition in Hungary, which shall be systematically reviewed are given in Chapter 2.3 based on the data provision of Paks NPP, BME NTI and KFKI AEKI.

The cost estimation does not cover the activities related to conditioning of the high level radwastes temporarily stored in the Püspökszilágy RWPS. These costs are included and recorded among the operational costs of the Püspökszilágy repository.

The cost estimation does not cover the costs of the back-shipment to Russia of the non nuclear power plant origin spent nuclear fuel.

4.4.4. Interrelations

The plans related to management of the spent fuel and the final disposal of high level radioactive wastes are closely linked to:

- extension of the interim spent fuel store (ISFS), determining the necessary degree of extension,
- the operational life-time of ISFS, which determines the commissioning deadline of the waste repository aimed for disposal of the high level radioactive wastes,
- the date of decommissioning of the power plant, which determines the time periods and dates of relaxation, re-commissioning and closure of the high level radioactive waste repository facility.

5. Interim storage of the spent nuclear fuel

5.1. Precedents

The precedents concerning the interim storage of the spent nuclear fuel of NPP origin is given in Chapter 4.1.2. During the past period the negotiations oriented to the back-shipment of the spent nuclear fuel to Russia have been renewed, however, since for the time being no agreement has been reached in this respect, in the mid and long term plans we are preparing the possibilities of the interim storage on the territory of Hungary.

The PURAM is going to initiate a licensing procedure for introduction in Hungary of two, different from each other methods for the interim storage of spent nuclear fuel assemblies. One would be the MVDS technology and its developed further versions, while the other one would be a dry, concrete-container solution. The construction of the forthcoming 5 modules (modules from 12 to - 16) will be conducted in accordance with the MVDS technology. The selection of the types of the further expansions will be due following to the completion of the licensing procedure.

As a consequence of the accident in Paks Nuclear Power Plant there were 30 irradiated fuel assemblies suffering damage, and thus one has to get prepared for final disposal of the damaged fuel assemblies in domestic conditions. With this aim on mind a concept design is under preparation, making a foundation for interim storage and final disposal of the damaged fuel assemblies in Hungary. The concept design will be based on the fact that the damaged fuel assemblies will be initially stored in the cooling pools in wet environment. The concept design investigates, when and in case of fulfillment of which requirements might the damaged fuel assemblies taken for storage in dry condition. Under such conditions shall be the further interim storage assured until the final disposal – which will take place together with the other spent fuel assemblies. On the basis of the concept design will be decision made on the method of the interim storage of the damaged fuel assemblies.

The issue of the interim storage of the non-nuclear power plant origin spent fuel in Hungary is discussed in Chapter 4.1.3.

5.2. The strategic target

The interim storage of the spent nuclear fuel shall be assured by means of extension and continuous operation of the facility.

5.3. Scheduling of the tasks

2007	-	Design and licensing of the solution relevant to the interim storage of the damaged fuel assemblies (continuation).
	-	Preparation of a concept design for the interim storage and final disposal of the damaged, irradiated fuel assemblies (continuation).
	-	Continuation of construction of the vault modules 12 to 16.
2008–2011	-	Execution of the interim storage of damaged assemblies.
	-	Construction of vaults 17 – 20.
2012–2017	-	Construction of vaults 21 – 25.
2047–2069	-	Unloading of the filled vaults, transfer of the spent fuel to the high level radioactive waste repository.
2007–2069	-	Continuous operation.
2070–2088	-	Guarded supervision together with the shut-down nuclear power plant.
2089–2104	-	Decommissioning simultaneously with the nuclear power plant.

5.4. Source data and information for the execution of the economical calculations

The cost data relevant of the expansion of ISFS - postulating utilization of the MVDS technology - could be calculated on the basis of earlier concluded contracts. The extension costs include the occasional licensing and public information costs as well.

The ISFS is a facility that can modularly be extended. The extension of the necessary storage capacity shall correspond to the needs of Paks Nuclear Power Plant Ltd. For the time being, taking into account the planned life-time of the power plant, the quantity of the spent fuel assemblies generated on annual level, and the quantity of the spent fuel assemblies presently stored on site, it is planned to construct 25 vaults.

The certain part of the planned operational and maintenance costs of ISFS is determined by the data supplied by Paks Nuclear Power Plant Ltd., and it is systematically updated in every year.
A significant correlation between the interim storage of the spent nuclear fuel and other waste management tasks exists in accordance with the below written:

- According to the reference scenario the spent fuel will be transferred from the site of ISFS in period between 2047 and 2069 to the high level radioactive waste repository. The storage and transportation costs, as well as their review is given in chapter 4.
- The emptied ISFS together with the shut down nuclear power plant will wait for decommissioning during the period between 2070 and 2089, while later on the decommissioning of the ISFS and transfer of the wastes will take place together with the same activities of the nuclear power plant beginning from 2090. The relevant costs are given in chapter 6, together with the planned review of the source data.

6. Decommissioning of Paks Nuclear Power Plant and other nuclear facilities

6.1. Precedents

The first reactor of Paks Nuclear Power Plant was connected to the national grid in 1982, while the fourth one was commissioned in 1987. The planned operational life-time of the nuclear power plant is 30 years, on this basis the assumption can be made that the fourth unit of the power plant will be finally shut down in 2017, if the efforts aimed to life-time extension will not result success.

The first study concerning the decommissioning of the power plant was made by the DECOM Slovakia Ltd. in 1993. The subject of this study was focused on the first two units of the power plant. The new version made in 1997 has already covered the topic of decommissioning of all four units and of the ISFS as well.

The fact that in 2003 the DECOM Slovakia Ltd. and the TS-Enercon Kft. have prepared the first version of the preliminary decommissioning plan of Paks Nuclear Power Plant and of the ISFS should be considered as a significant progress. The preliminary decommissioning plan of Paks Nuclear Power Plant includes the same decommissioning alternatives as the study from 1997, however this is already done on design level, and the relevant recommendations of IAEA are outmost taken into account. The preliminary decommissioning plan of the ISFS investigates only a decommissioning alternative that is closely linked to the decommissioning plan of the power plant "closed and continuously guarded-supervised condition for 70 years".

The study from 1997, as well as the preliminary decommissioning plan of the power plant from 2003 have investigated all together five different decommissioning alternatives. From those, from point of view of the cost effect the alternative "closure under supervision for 70 years" was deemed to be the most favorable one, and thus this was chosen as reference scenario as well. According to this following transfer of the spent fuel assemblies to the ISFS the secondary circuit part of the power plant would be decommissioned, while the parts including the radioactive materials and equipment would be closed and remain in a continuous guarded-supervised condition for 70 years.

The training reactor of the Budapest Technical University was commissioned in 1971, to meet the training needs of the Hungarian nuclear experts' community. It is running today at 100 kW nominal power level, and has its valid operation license up to 2007.

The good technical state of the reactor probable allows that following the periodical safety review (PSR) actual in 2007, the facility could get the operation license even for further 2 x 10 years. That necessity is expressly supported by the designed life-time extension of the Paks NPP and education of the future plant personnel.

Based on the above-written, the decommissioning of the facility shall be considered for the period beyond 2007. The preparation of the decommissioning design is in progress. This document is necessary for the renewal of the operational license, due in 2007, and thus its finalization will have to be done only later on.

The research reactor of the Central Institute of Physical Researches was built in 1959. Its core was modified in 1967, by introducing a new fuel element. Between 1986 and 1992 the facility was refurbished, a new vessel was mounted and the thermal power was increased to 10 MW. The facility performs research and isotope production tasks, for which a neutron flux of 2.2 x 10^{14} n/cm^2 is available.

The periodical safety review of the research reactor took place in 2003, on the basis of which the Nuclear Safety Directorate of the Hungarian Atomic Energy Agency has issued an operational license, valid until withdrawal. The next periodical safety review will be due in 2013.

By taking into account that designed operational life of this reactor is of 30 years, its operation is scheduled up to 2023. AEA Technology and INITEC accomplished decommissioning study referring to the reactor in 1997, within the framework of the PHARE project. Another decommissioning plan was made by the contribution of the Belgoprocess, the SCK CEN and the STUDSVIK RADWASTE in 1998.

6.2. The strategic target

One has to get prepared for decommissioning of the Paks Nuclear Power Plant by taking into account the "supervised closure for 70 years" version.

In order to be able to incorporate the achievements of the technical development all around the world and of the gained experiences, the decommissioning study shall be periodically reviewed.

6.3. Schedule of the tasks

2006-2007	-	Establishing the computer database necessary for accomplishing the ultimate plan of decommissioning.
	-	Review of the preliminary decommissioning plan.
2010–2022	-	Finalization and licensing of the decommissioning plan.
	-	Phase by phase shut down of the units.

	-	Transfer of the spent fuel assemblies to the ISFS.
	-	Decommissioning of the non- active parts of the power plant.
	-	Preparation of the active parts of the nuclear power plant for surveillance.
2022–2082	-	Surveillance of the active parts of the nuclear power plant (beyond 2070 together with the ISFS).
2082–2104	-	Decommissioning of the active parts of the nuclear power plant
	-	Decommissioning of ISFS.

6.4. Source data and information for the execution of the economical calculations

The cost data relevant to the decommissioning and demolishing of the power plant are derived from the study from 2003 titled *"Selected chapters of the preliminary decommissioning plan of Paks Nuclear Power Plant"* No. STD/PAKS/VD/06-02, and from the document No. STD/PAKS/VD/07-02 *"Preliminary decommissioning plan of the ISFS"*.

The preliminary decommissioning plan has to be regularly upgraded, until the final version of the demolishing plan will be completed.

The decommissioning of the power plant, as the latest in time of the tasks prescribed by the law, is in close relationship with other waste management tasks:

- The decommissioning of the power plant will result in generation of significant quantity of wastes of various activity, and accordingly at the time of design of the various repositories this shall be taken into account, and at the same time the time of the closure of the repositories shall be adjusted to the time of the decommissioning.
- The decommissioning of the power plant and of the ISFS will take place at the same time, so the supervision of the ISFS shall be adjusted to this.

7. Other tasks

7.1. Introduction

The plans related to the main professional tasks prescribed by the Nuclear Act and its execution orders were described in the above chapters. In the present chapter those activities are treated which are necessary for the execution of the main tasks, and are incorporated into our long-term plans from financial point of view. Here belongs the operation of PURAM, financing the Trustee of the Fund, the authority supervision fees and the public system support.

7.2. Operation of PURAM

The PURAM was established on June 2, 1998. The operation of the company and accordingly its financing shall be taken into consideration until the end of completion of the last task stated in the long-term plan. The annual operational cost of PURAM at a price level of July 2007 has been 2718.8 Million Hungarian Forints. This cost includes the operational costs of the Püspökszilágy RWPS as well and partly the costs of the ISFS operations, the authority supervision fees, the half-year operational costs of the 1st phase of the Bátaapáti waste repository, including the costs of transportation of the first 3000 waste barely as well.

7.3. The costs of the fund trustee

According to paragraph (2) of article 4. of the order of Ministry of Home Affairs No. [67/1997. (XII. 18.) IKIM] 41/2004. (VII. 7.) “The tasks performed by the HAEC in relation to management of the Fund, as well as the services of experts, or experts’ group used shall be financed from the Fund”.

In accordance with this in 2007 the fund trustee will use for the purposes of operation 104 Million Hungarian Forints. This operational cost shall be taken into account until the end of the execution of the last task to be financed from the fund. It is necessary to review the operational costs of the fund trustee annually.

7.4. Public support system

According to paragraph (4) of Article 10 of the Nuclear Act: “In order to provide the systematic information of the public living in the vicinity of the facility, the nuclear power plant as well as the licensee of the radioactive waste repository shall promote the creation of a public control and information society, and may provide assistance to the operation of it. The licensee is authorized to provide promotion to the municipality supervision and information societies to be established, to the area development municipality societies which will be established in the given area, and furthermore to the municipalities which are the members of these societies - even from the Central Nuclear Financial Fund – which amount might be used for information, operational, area and town development purposes”.

According to Article 67 of the Nuclear Act the Government is authorized to regulate in resolutions: „o) the rules of the promotions to be provided from the Central Nuclear Financial Fund to municipality supervision and information societies which were established in order to provide systematic information to the public leaving in the areas of repositories of radioactive wastes, interim or ultimate repositories of spent fuel assemblies, as well as in areas of site selection explorations for the above mentioned facilities, furthermore to the area development municipality societies which will be established in the given area, and to the municipalities which are the members of these societies, taking into account the rules set forth in paragraph (4) of Article 10.”

Until the above mentioned Governmental resolution will not be published, the level of the promotions to be paid to the municipality societies will be adjusted to the established practice and to the character of the activities going on in the given area.

8. Calculation of the payments to the CNFF in 2007

8.1. The method of the calculations

The calculations were performed in accordance with the calculation algorithms given in the *“Rules of development of the long-term plans and relevant estimations in relation to activities to be financed from the Central Nuclear Financial Fund”* approved on January 18, 2000 meeting of the Experts’ Committee of HAEC.

8.2. The most important changes compared to the calculations included in the fifth mid – and long term plan

The cost of disposal of the low and interim level radwastes was estimated in the earlier mid and long term plans based on the document titled *“Paks Nuclear Power Plant, Units 1-4, “Final disposal of the low and interim level radioactive wastes – Site independent cost estimation* *comparison"* made by ETV-Erőterv in 1995 by taking into account the actual inflation rates. As it was presented in Chapter 3.3.3. , the cost estimation of our present plan was performed on the basis of the document titled *„Final deposition of low and interim level nuclear power plant origin wastes in the underground repository planned to be constructed in vicinity of Bátaapáti; INVESTMENT PROPOSAL"*.

- The deviation between the costs forecasted by the two, different from each other documents, and the decreasing level of the operational costs – which might be today already better estimated – together lead to the decrease of the present value of the project. This decreasing tendency is further enhanced by the fact, that the financial amount spent during the previous years shall be deducted from the project cost.
- The activities related to disposal of the high level radwastes and of the spent fuel assemblies – and accordingly the cost estimation of the necessary activities were calculated on the basis of the document marked TS(R)/6/25 and titled *„Concept design and cost estimation of the deep geological waste repository aimed for final disposal of the Hungarian high level and long-living radwastes, as well as of the spent nuclear fuel assemblies"*. Such approach leads in relation to uranium disposal to a value higher than the earlier applied 500 USD/kg cost. Having on mind, that these values were derived from the realistic circumstances of the waste disposal in Hungary, provide unambiguously more precise cost estimation, than the earlier data gained from the international literature.
- The support of the local municipalities in calculated by PURAM in accordance with a new system. **The amount of the promotion paid to the municipality societies in 2007 will be** 900 Million HUF. The promotion of the different societies will substantially depend from the operational life-time of the facilities located in the given areas.

The input data of the calculations are given in Table 8.2.1., while the calculations in Table 8.2.2. The summary of the costs of activities financed from the CNFF is given in Table 8.2.3, while the cash flow of the costs is presented in Figure 8.2.4.

8.3. The amount of the payments to the CNFF

According to the calculations in 2007 Paks Nuclear Power Plant Ltd. shall pay an amount of 22 827.5 Million Hungarian Forints to the CNFF.

Table 8.3.1. presents the professional recommendation in relation to payments in and from the CNFF in 2007. Table 8.3.2. summarizes the main tasks of the projects financed in 2007 from the CNFF as well as the costs thereof.

8.4. Prospective expenditures of the State Budget institutions and their timing.

Table 8.4.1 summarizes the expenditures of the State Budget institutions connected to the management of the spent fuel and decommissioning. As it was mentioned earlier, these expenditures will be paid by the Budget in the year of their emergence. Here the costs are indicated also at the 2007 year price level. In connection with the Table it shall be mentioned that the amount of the costs of the planned back-shipment of the spent fuel assemblies to Russia as well as the cash-flow of these costs are unknown at the present time. According to our information these cost are anticipated to arise earliest in 2008, so their actualization might take place in the next mid- and long term plan.

Tables, figures

Table 2.1.1.– Classification of the Radioactive Wastes

Category of the Radioactive Waste	**Activity Concentration [kBq/kg]**
Low Level Activity	1 MEAK – 10^3 MEAK
Intermediate Level Activity	> 10^3 MEAK

Note:

- Where MEAK: exemption activity concentration
- If the waste contains trans-uranium elements, a unique classification is required.

Table 2.1.2.: The classification of the radioactive wastes in case of occurrence of different radio-isotopes

Radioactive waste class	**Comparison of the activity concentration**
Low level activity	$\sum_i \frac{AK_i}{MEAK_i} \leq 10^3$
Interim level activity	$\sum_i \frac{AK_i}{MEAK_i} > 10^3$

where AK_i is the activity concentration of the i radio-isotope, being present in the waste, while $MEAK_i$ is the exemption activity concentration of the i radio-isotope.

Table 2.2.1. – The Amount of the Radioactive Wastes and Spent Fuel Assemblies Stored within the Sites of the Paks NPP and RWPS Facility (As per 1 January, 2004).

Location of the storage	**LOW AND INTERMEDIATE LEVEL**				**HIGH LEVEL ACTIVITY WASTE**		**SPENT NUCLEAR FUEL**			
	Storage capacity		**Stored Quantity**		**Storage capacity**	**Stored Quantity**	**Storage capacity**		**Stored Quantity**	
	gross m^3	**Pieces of 200 liters drums**	**gross m^3**	**Pieces of 200 liters drums**	**m^3**	**m^3**	**piece**	**tU***	**piece**	**tU***
RWPS Facility (solid waste)	5040	---	5040	---	---	---	---	---	---	---
Paks NPP Plant Site (solid waste)	---	7852	---	6903	222.8	63.3	---	---	---	---
Paks NPP Plant Site (liquid waste)	9950	---	5465.4	---	---	---	---	---	---	---
Paks NPP Plant Site cooling ponds	---	---	---	---	---	---	2600	301.6	2117	245.6
ISFS at Paks	---	---	---	---	---	---	4950	574.2	4267	495.0

* The unit value of the heavy metal content of the spent fuel assemblies was calculated on the basis 116 kgU heavy metal/fuel assembly.

Table 2.2.2.– Amount of the Spent Fuel used and to be used within the Plant Sites of the Research Institute for Nuclear Energy of Central Institute of Physical Researches (KFKI AEKI) and in Nuclear Institute of the Budapest Technical University, (BME)

Institution	Duration of utilization	Type	Enrichment [%]	Nominal U mass [gU] ($U^{235} + U^{238}$)	Burn-up level [%]	Average heavy metal content of the spent (irradiated) fuel assembly [g]
KFKI AEKI	1959 – 1966	EK-10	10	1250	25	1220
	1967 – 2010 (?)	VVR-SZM	36	111	50	91
	1992 – 2010 (?)	VVR-M2	36	122	60	96
	2010 (?) – up to end of the operational life-time	VVR-M2	20	250	60	220
BME NTI	in course of the total operational life-time	EK-10 (modified)	10	1250	<1%	1249

Table 2.2.3: The characteristics of the spent fuel storage facilities of KFKI AEKI and level of their utilization as per January 1, 2006

<table>
<tr><th></th><th>Total capacity
capsule [piece] / single assembly [piece]</th><th>Number of the stored fuel assemblies</th><th>Number of the occupied storage positions (capsules) [piece]</th><th>Quantity of the stored heavy metal [kgU]</th><th>Level of utilization [%]</th></tr>
<tr><td>External storage</td><td>752 / 2256</td><td>1179 (VVR)
82 (EK-10)</td><td>1179 : 3 + 82 = 475</td><td rowspan="2">226.5</td><td>54</td></tr>
<tr><td>Internal storage</td><td>184 / 552</td><td>323 (VVR)</td><td>323 : 3 = 107 + 1</td><td>75</td></tr>
<tr><td></td><td></td><td></td><td>In total: 582 + 1</td><td></td><td></td></tr>
</table>

Table 2.3.1.1 – Estimation of the necessary volume capacity of the final repository for low and interim level wastes to be newly constructed

		January 1, 2006 [m³]	Annual generation [m³]	Due to the incident 2006-2007 [m³]	To be generated by the end of the life-time [m³]	Treatment	Solid waste to be disposed [m³]	Waste packages	
								Barrels [piece]	Other [piece]
SOLID	Compacted	1381.4	190	160	3251.4	None	3251.4	16257 (200 l)	
SOLID	Big sized	Not centralized	Not divided	---	600	None	600.0		150 (4 m³ container)
SOLID	Cs-column storage container	---	Not divided	2.1	2.1	None	2.1		3 (0,7 m³ container)
SOLID	Decommissioning waste[1]	---	---	---	---	None	17864	87845 (200 l)	113 (3,675 m³ container)
K	Resin	134,60	5	40.5	220.1	Cementing 60 l / 200 l	733.7	3668 (200 l mixing)	

[1] The liquid wastes which will be generated are indicated in this column in solidified form together with the other decommissioning solid wastes.

Table 3.5.1.: The quantity of the spent nuclear fuel generated and to be generated in the future in the Budapest Research Reactor operated by KFKI AEKI

Time, Quantities / Type	1959 – January 1, 2005			1959 – 2010			1959 – 2023		
	spent fuel assemblies [piece]	**necessary storage positions [piece capsule]**	**heavy metal mass [kgU]**	**spent fuel assemblies [piece]]**	**necessary storage positions [piece capsule]**	**heavy metal mass [kgU]]**	**spent fuel assemblies [piece]]**	**necessary storage positions [piece capsule]**	**heavy metal mass [kgU]**
EK-10	82	82	100.04	82	82	100.04	82	82	100.04
VVR-SzM	1210	500 + 1	109.83	1293	690	117.66	1293	690	117.66
VVR-M2(36)	292		28.03	777		74.59	777		74.59
VVR-M2(20)	---	---	---	---	---	---	900	300	198.00
TOTAL		**582 + 1**	**237.90**		**772**	**292.3**		**1072**	**490.3**

Table 2.3.5.2. : The quantity of the spent nuclear fuel generated in the training reactor operated by BME NTI

Time, Quantities / Type	1971 – January 1, 2006			1971 – 2008			1971 – 2027		
	spent fuel assemblies [piece]	**necessary storage positions [piece capsule]**	**heavy metal mass [kgU]**	**spent fuel assemblies [piece]**	**necessary storage positions [piece capsule]**	**heavy metal mass [kgU]**	**spent fuel assemblies [piece]**	**necessary storage positions [piece capsule]**	**heavy metal mass [kgU]**
EK-10	0	0	0	24	24	29.98	48	48	59.96

Table 8.4.1. – The anticipated costs of the state budget institutions in relation to spent fuel management and to decommissioning of the facilities on price level of year 2005.

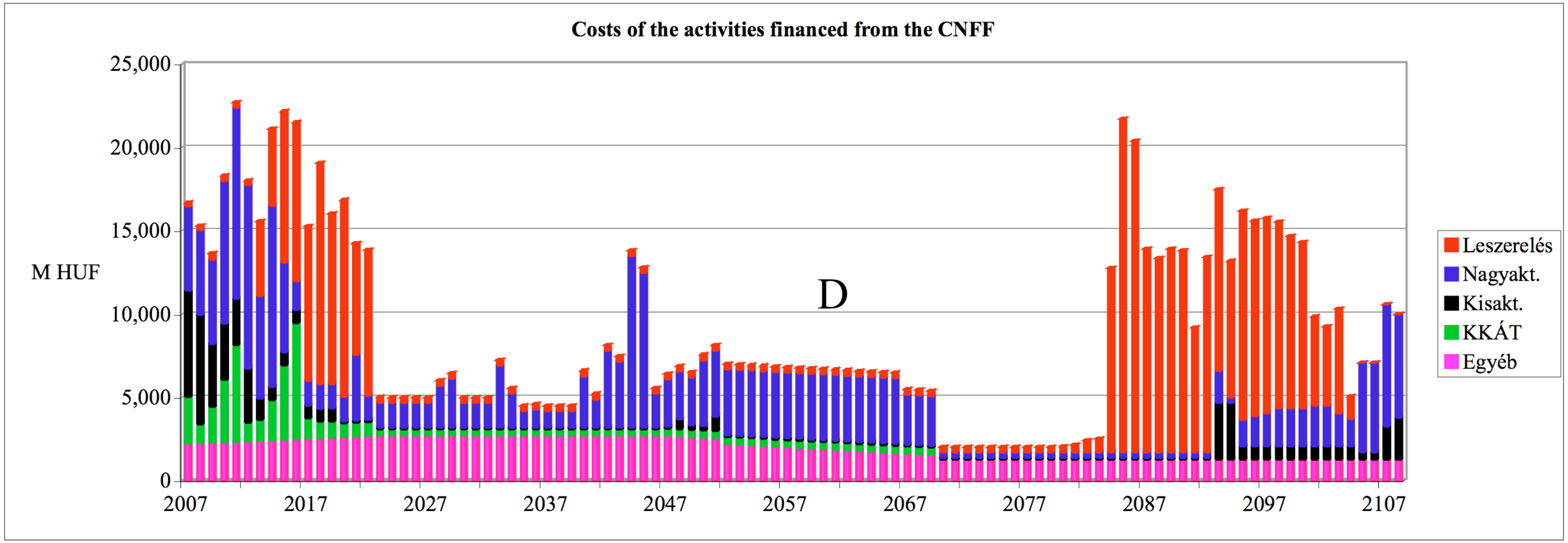
KFKI AEKI	**Justification of the interim storage of the spent nuclear fuel in Hungary**	Due in case of failure of back-shipment to Russia (after 2010) Cost 10-10 M Hungarian Forints
	Disposal of the spent nuclear fuel	Due in case of failure of back-shipment to Russia (after 2047) Cost: 8083.65 M Hungarian Forints
	Decommissioning of the research reactor	Due: after 2023 Cost: 766.61 M Hungarian Forints
BME NTI	**Justification of the back-shipment and of the encapsulation of the spent nuclear fuel**	Due in 2007 Cost 14 M Hungarian Forints
	Disposal of the spent nuclear fuel	Due: after 2047 Cost: 351.46 M Hungarian Forints
	Decommissioning of the training reactor	Due: after 2027 Cost and method: to be determined later

Notes:

The above Table does not take into consideration of the potential back-shipment of the spent nuclear fuel assemblies to Russia and the costs thereof.

YEAR	Extension of the LLW and ILW repository including VAT	Operation of the LLW and ILW repository 1. including VAT	Relaxation of the LLW and ILW repository including VAT	Operation of the LLW and ILW repository 2. including VAT	Transportation to the LLW and ILW repository 1. including VAT	Transportation to the LLW and ILW repository 2. including VAT	Closure of the LLW and ILW repository including VAT *	Preparation of the high level radwaste repository including VAT	Construction of the high level radwaste repository including VAT	Operation of the high level radwaste repository 1 including VAT	Relaxation of the high level radwaste repository including VAT	Operation of the high level radwaste repository 2 including VAT	Transportation to the LLW and ILW repository 1. including VAT	Transportation to the LLW and ILW repository 2. including VAT	Closure of the LLW and ILW repository including VAT *
2007	5,500.0	195.9			12.4			5,066.0							
2008	5,600.0	372.3						5,066.0							
2009	2,000.0	753.6			12.4			5,066.0							
2010	1,500.0	753.6			12.4			8,557.0							
2011	2,000.0	753.6			12.4			11,455.1							
2012	2,500.0	753.6			12.4			11,015.1							
2013	500.0	753.6			12.4			6,159.4							
2014		753.6			12.4			10,860.4							
2015		753.6			12.4			5,381.8							
2016		753.6			12.4			1,728.9							
2017		753.6			12.4			1,480.0							
2018		753.6			12.4			1,480.0							
2019		753.6			12.4			1,480.0							
2020			116.8					1,480.0							
2021			116.8					3,959.6							
2022			116.8					1,480.0							
2023			116.8					1,480.0							
2024			116.8					1,480.0							
2025			116.8					1,480.0							
2026			116.8					1,480.0							
2027			116.8					1,480.0							
2028			116.8					2,495.8							
2029			116.8					2,937.1							
2030			116.8					1,480.0							
2031			116.8					1,480.0							
2032			116.8					1,480.0							
2033			116.8						3,714.4						
2034			116.8						2,047.8						
2035			116.8						990.2						
2036			116.8						1,075.0						
2037			116.8						990.2						
2038			116.8						990.2						
2039			116.8						990.2						
2040			116.8						3,077.0						
2041			116.8						1,692.6						
2042			116.8						4,613.5						
2043			116.8						3,943.5						
2044			116.8						10,285.9						
2045			116.8						9,258.0						
2046			116.8						2,037.0						
2047			116.8							1,876.9			966.0		
2048			116.8							1,871.5			999.7		
2049			116.8							1,871.5			999.7		
2050			116.8							2,939.8			999.7		
2051			116.8							2,939.8			999.7		
2052			116.8							2,939.8			999.7		
2053			116.8							2,939.8			999.7		
2054			116.8							2,939.8			999.7		
2055			116.8							2,939.8			999.7		
2056			116.8							2,938.4			999.7		
2057			116.8							2,938.4			999.7		
2058			116.8							2,938.4			999.7		
2059			116.8							2,938.4			999.7		
2060			116.8							2,938.4			999.7		
2061			116.8							2,938.4			999.7		
2062			116.8							2,938.4			999.7		
2063			116.8							2,938.4			999.7		
2064			116.8							2,938.4			999.7		
2065			116.8							2,938.4			999.7		
2066			116.8							2,933.1			999.7		
2067			116.8							1,991.3			999.7		
2068			116.8							1,991.3			999.7		
2069			116.8							1,976.5			999.7		
2070			116.8								336.4				
2071			116.8								336.4				
2072			116.8								336.4				
2073			116.8								336.4				
2074			116.8								336.4				
2075			116.8								336.4				
2076			116.8								336.4				
2077			116.8								336.4				
2078			116.8								336.4				
2079			116.8								336.4				
2080			116.8								336.4				
2081			116.8								336.4				
2082			116.8								336.4				
2083			116.8								336.4				
2084			116.8								336.4				
2085			116.8								336.4				
2086			116.8								336.4				
2087			116.8								336.4				
2088			116.8								336.4				
2089			116.8								336.4				
2090			116.8								336.4				
2091			116.8								336.4				
2092			116.8								336.4				
2093	3,285.5		116.8								1,941.5				
2094	3,285.5		116.8								336.4				
2095				734.8		72.3						1,478.6		110.3	
2096				734.8		72.3						1,477.3		322.9	
2097				734.8		72.3						1,477.3		497.8	
2098				734.8		72.3						1,477.3		807.3	
2099				734.8		72.3						1,477.3		807.3	
2100				734.8		72.3						1,477.3		807.3	
2101				734.8		72.3						1,477.3		968.7	
2102				734.8		72.3						1,477.3		955.3	
2103				734.8		72.3						1,477.3		511.3	
2104				734.8		72.3						1,477.3		188.4	
2105							439.9					672.7			4,709.0
2106							439.9					672.7			4,709.0
2107							2,004.2					672.7			6,647.8
2108							2,512.0					672.7			5,545.9
In total:	26,170.9	8,857.8	8,759.6	7,347.6	148.2	722.6	5,396.1	98,988.1	45,705.6	61,535.1	10,014.1	17,465.2	22,958.6	5,976.4	21,611.8

YEAR	Construction and extension of the ISFS including VAT	Renewal of the ISFS including VAT	Operation of the ISFS including VAT	Surveillance fee	Operation of PURAM including VAT	Operation of the Püspökszilágy repository including VAT *	Püspökszilágy repository including VAT *	Decommissioning of Paks NPP and ISFS including VAT	Fund Trustee	Support of the Municipalities	Total costs	Total costs discounted	Income II: balance from previous year	Income III: payments 1998-2017.	Total income	Total income discounted
2007	1,797.4	183.5	830.3	349.3	990.9	340.0	639.2	212.7	104.0	900.0	17,121.6	17,121.6	107,897.0	22,827.5	130,724.5	130,724.5
2008	162.4	143.2	830.3	376.3	990.9	340.0	594.3	280.0	104.0	900.0	15,759.6	15,300.6		22,827.5	22,827.5	22,162.6
2009	1,167.4	148.2	830.3	405.5	990.9	340.0	1,001.2	367.9	104.0	900.0	14,087.4	13,278.7		22,827.5	22,827.5	21,517.1
2010	2,782.3	132.6	830.3	432.5	990.9	340.0	1,087.4	317.9	104.0	900.0	18,740.9	17,150.6		37,969.8	37,969.8	34,747.7
2011	4,820.8	148.5	830.3	461.8	990.9	340.0		317.9	104.0	900.0	23,135.2	20,555.3		37,969.8	37,969.8	33,735.6
2012	119.3	147.1	830.3	488.8	990.9	340.0		235.7	104.0	900.0	18,437.3	15,904.1		37,969.8	37,969.8	32,753.1
2013	201.8	232.0	830.3	518.0	990.9	340.0		4,476.3	104.0	900.0	16,018.7	13,415.4		37,969.8	37,969.8	31,799.1
2014	1,459.2	132.6	830.3	545.0	990.9	340.0		4,640.8	104.0	900.0	21,569.2	17,537.8		28,477.3	28,477.3	23,154.7
2015	3,477.9	164.4	830.3	574.3	990.9	340.0		9,072.6	104.0	900.0	22,602.1	17,842.3		18,984.9	18,984.9	14,986.8
2016	6,026.0	132.6	830.3	601.3	990.9	340.0		9,520.3	104.0	900.0	21,940.2	16,815.3		18,984.9	18,984.9	14,550.3
2017	149.2	239.9	830.3	635.0	990.9	340.0		9,293.9	104.0	900.0	15,729.3	11,704.0		9,492.4	9,492.4	7,063.3
2018		159.1	830.3	668.8	990.9	340.0		13,270.6	104.0	900.0	19,509.6	14,094.2				
2019		148.5	830.3	702.5	990.9	340.0		10,203.3	104.0	900.0	16,465.4	11,548.5				
2020			830.3	736.3	990.9	340.0		11,790.9	104.0	900.0	17,289.2	11,773.1				
2021			830.3	770.0	990.9	340.0		6,688.0	104.0	900.0	14,699.7	9,718.2				
2022			830.3	803.8	990.9	340.0		8,719.9	104.0	900.0	14,285.7	9,169.4				
2023			358.0	834.6	990.9	340.0		339.9	104.0	900.0	5,464.2	3,405.1				
2024			358.0	834.6	990.9	340.0		327.0	104.0	900.0	5,451.3	3,298.1				
2025			358.0	834.6	990.9	340.0		327.0	104.0	900.0	5,451.3	3,202.1				
2026			358.0	834.6	990.9	340.0		327.0	104.0	900.0	5,451.3	3,108.8				
2027			358.0	834.6	990.9	340.0		327.0	104.0	900.0	5,451.3	3,018.3				
2028			358.0	834.6	990.9	340.0		327.0	104.0	900.0	6,467.1	3,476.4				
2029			358.0	834.6	990.9	340.0		327.0	104.0	900.0	6,908.5	3,605.5				
2030			358.0	834.6	990.9	340.0		327.0	104.0	900.0	5,451.3	2,762.1				
2031			358.0	834.6	990.9	340.0		327.0	104.0	900.0	5,451.3	2,681.7				
2032			358.0	834.6	990.9	340.0		327.0	104.0	900.0	5,451.3	2,603.6				
2033			358.0	834.6	990.9	340.0		327.0	104.0	900.0	7,685.7	3,563.8				
2034			358.0	834.6	990.9	340.0		327.0	104.0	900.0	6,019.1	2,709.7				
2035			358.0	834.6	990.9	340.0		327.0	104.0	900.0	4,961.6	2,168.6				
2036			358.0	834.6	990.9	340.0		327.0	104.0	900.0	5,046.4	2,141.4				
2037			358.0	834.6	990.9	340.0		327.0	104.0	900.0	4,961.6	2,044.1				
2038			358.0	834.6	990.9	340.0		327.0	104.0	900.0	4,961.6	1,984.6				
2039			358.0	834.6	990.9	340.0		327.0	104.0	900.0	4,961.6	1,926.8				
2040			358.0	834.6	990.9	340.0		327.0	104.0	900.0	7,048.4	2,657.4				
2041			358.0	834.6	990.9	340.0		327.0	104.0	900.0	5,663.9	2,073.2				
2042			358.0	834.6	990.9	340.0		327.0	104.0	900.0	8,584.9	3,050.9				
2043			358.0	834.6	990.9	340.0		327.0	104.0	900.0	7,914.8	2,730.9				
2044			358.0	834.6	990.9	340.0		327.0	104.0	900.0	14,257.3	4,775.9				
2045			358.0	834.6	990.9	340.0		327.0	104.0	900.0	13,229.3	4,302.5				
2046			358.0	834.6	990.9	340.0		327.0	104.0	900.0	6,008.4	1,897.2				
2047			419.2	834.6	990.9	340.0		327.0	104.0	900.0	6,875.5	2,107.7				
2048			419.2	797.1	990.9	340.0	459.5	327.0	104.0	900.0	7,325.8	2,180.4				
2049			419.2	759.6	990.9	340.0	151.0	327.0	104.0	900.0	6,979.7	2,016.9				
2050			419.2	722.1	990.9	340.0	147.9	327.0	104.0	900.0	8,007.5	2,246.4				
2051			419.2	684.6	990.9	340.0	752.7	327.0	104.0	900.0	8,574.7	2,335.5				
2052			419.2	647.1	665.5			327.0	104.0	900.0	7,119.1	1,882.6				
2053			419.2	609.6	665.5			327.0	104.0	900.0	7,081.6	1,818.1				
2054			419.2	572.1	665.5			327.0	104.0	900.0	7,044.1	1,755.8				
2055			419.2	534.6	665.5			327.0	104.0	900.0	7,006.6	1,695.6				
2056			419.2	497.1	665.5			327.0	104.0	900.0	6,967.7	1,637.1				
2057			419.2	459.6	665.5			327.0	104.0	900.0	6,930.2	1,580.8				
2058			419.2	422.1	665.5			327.0	104.0	900.0	6,892.7	1,526.5				
2059			419.2	384.6	665.5			327.0	104.0	900.0	6,855.2	1,474.0				
2060			419.2	347.1	665.5			327.0	104.0	900.0	6,817.7	1,423.2				
2061			419.2	309.6	665.5			327.0	104.0	900.0	6,780.2	1,374.1				
2062			419.2	272.1	665.5			327.0	104.0	900.0	6,742.7	1,326.7				
2063			419.2	234.6	665.5			327.0	104.0	900.0	6,705.2	1,280.9				
2064			419.2	197.1	665.5			327.0	104.0	900.0	6,667.7	1,236.7				
2065			419.2	159.6	665.5			327.0	104.0	900.0	6,630.2	1,193.9				
2066			419.2	122.1	665.5			327.0	104.0	900.0	6,587.3	1,151.6				
2067			419.2	84.6	665.5			327.0	104.0	900.0	5,608.0	951.9				
2068			419.2	47.1	665.5			327.0	104.0	900.0	5,570.5	918.0				
2069			419.2	9.6	665.5			327.0	104.0	900.0	5,518.2	882.9				
2070					665.5			327.0	104.0	600.0	2,149.7	333.9				
2071					665.5			327.0	104.0	600.0	2,149.7	324.2				
2072					665.5			327.0	104.0	600.0	2,149.7	314.7				
2073					665.5			327.0	104.0	600.0	2,149.7	305.6				
2074					665.5			327.0	104.0	600.0	2,149.7	296.7				
2075					665.5			327.0	104.0	600.0	2,149.7	288.0				
2076					665.5			327.0	104.0	600.0	2,149.7	279.6				
2077					665.5			327.0	104.0	600.0	2,149.7	271.5				
2078					665.5			327.0	104.0	600.0	2,149.7	263.6				
2079					665.5			327.0	104.0	600.0	2,149.7	255.9				
2080					665.5			357.8	104.0	600.0	2,180.4	252.0				
2081					665.5			438.3	104.0	600.0	2,260.9	253.7				
2082					665.5			716.5	104.0	600.0	2,539.1	276.6				
2083					665.5			802.4	104.0	600.0	2,625.1	277.7				
2084					665.5			11,041.6	104.0	600.0	12,864.2	1,321.0				
2085					665.5			19,992.8	104.0	600.0	21,815.5	2,175.0				
2086					665.5			18,676.7	104.0	600.0	20,499.3	1,984.3				
2087					665.5			12,202.5	104.0	600.0	14,025.1	1,318.0				
2088					665.5			11,631.8	104.0	600.0	13,454.4	1,227.6				
2089					665.5			12,204.6	104.0	600.0	14,027.3	1,242.6				
2090					665.5			12,094.5	104.0	600.0	13,917.1	1,196.9				
2091					665.5			7,492.5	104.0	600.0	9,315.2	777.8				
2092					665.5			11,710.3	104.0	600.0	13,532.9	1,097.0				
2093					665.5			10,878.9	104.0	600.0	17,592.1	1,384.6				
2094					665.5			8,173.8	104.0	600.0	13,281.9	1,014.9				
2095					665.5			12,545.0	104.0	600.0	16,310.5	1,210.0				
2096					665.5			11,735.8	104.0	600.0	15,712.5	1,131.7				
2097					665.5			11,722.5	104.0	600.0	15,874.1	1,110.0				
2098					665.5			11,174.5	104.0	600.0	15,635.6	1,061.5				
2099					665.5			10,314.1	104.0	600.0	14,775.1	973.9				
2100					665.5			9,964.7	104.0	600.0	14,425.7	923.2				
2101					665.5			5,320.4	104.0	600.0	9,942.9	617.8				
2102					665.5			4,753.7	104.0	600.0	9,362.7	564.8				
2103					665.5			6,261.5	104.0	600.0	10,426.6	610.6				
2104					665.5			1,319.7	104.0	600.0	5,161.8	293.5				
2105					665.5				104.0	600.0	7,191.2	397.0				
2106					665.5				104.0	600.0	7,191.2	385.4				
2107					665.5				104.0	600.0	10,694.2	556.4				
2108					665.5				104.0	600.0	10,100.1	510.2				
In total:	22,163.8	2,111.9	31,518.3	38,807.8	82,523.8	15,300.0	4,833.3	331,589.5	10,608.0	80,100.0	961,214.3	367,194.8	107,897.0	296,301.1	404,198.1	367,194.8


Costs of the activities financed from the CNFF
M HUF
25,000
20,000
15,000
10,000
5,000
0
2007
2017
2027
2037
2047
2057
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