'National Programme of Hungary on the management of spent fuel and radioactive waste'

Strategic Environmental Assessment

Radioactive Waste Treatment and Disposal Facility (Püspökszilágy)

Interim Spent Fuel Storage Facility (Paks)

National Radioactive Waste Repository (Bátaapáti)

Budapest, December 2015

Pte. Ltd. for Environment, Economics, Technology, Commerce, Services and Development

Msz: 121/2015

'National Programme of Hungary on the management of spent fuel and radioactive waste'

Strategic Environmental Assessment

Prepared by

ÖKO Zrt. and	**Golder Associates (Hungary) Zrt.**
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Budapest, December 2015

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1.1. Preliminaries, elaboration of the National Programme, definition of the problem to be managed

Pursuant to the provisions of Article 4 of the Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste (hereinafter: Directive), the Member States must elaborate national policies for the management of spent fuel and radioactive waste. For the compliance with the provisions of the Directive, the Act CI of 2013 amending the Act CXVI of 1996 on atomic energy (hereinafter: Atomic Energy Act) required that the Parliament must adopt a national policy for the submission of the Government. **In accordance with the requirement above, the Hungarian Parliament by its Resolution No. 21/2015 of 4 May 2015 adopted the document on the national policy on the management of spent fuel and radioactive waste.**

In accordance with the Atomic Energy Act, the Government must adopt a National Programme – which presents the implementation of objectives of the National Policy – for the management of spent fuel and radioactive waste, covering the scope of all the stages from production until final disposal and decommissioning of nuclear facilities, the boundary conditions for which must be defined in the National Policy. Under the Act, the National Policy and the National Programme must be reviewed every five years. Review may also take place earlier when justified by the occurrence of new circumstances, the technical scientific progress or the advancement of some technical project in the course of implementation of the National Programme.
The National Policy defines the fundamental principles to be applied in the elaboration and implementation of the National Programme. It presents the current situation, the application of the radioactive materials and nuclear energy, the regulatory and institutional frameworks, the rules for the classification of radioactive waste, the requirements regarding the back-end of the fuel cycle, management of radioactive waste and decommissioning of nuclear facilities. The National Policy provides a summary of the requirements and methods for the engagement of the citizens in decision-making, i.e., the principles of ensuring publicity.

The details of implementation of the National Policy are included in the National Programme. One of the instruments of public participation in case of the completed document is the so-called strategic environmental assessment (hereinafter: SEA), which is included in this documentation.

1.2. Necessity and objective of the environmental assessment

The European Union (hereinafter: EU) expanded the practice of environmental impact assessments completed before the development projects in the early 2000's also to the level of stages preceding the investment projects (e.g. sector policies, plans and programmes) in order to introduce the environmental criteria in an as early as possible stage of the planning processes. This is regulated by the Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment (Directive on strategic environmental assessments, as used in Hungary). The introduction and integration of the Directive in Hungary had been implemented in the Government Decree No. 2/2005 of 11 January 2005 on the environmental assessment of certain plans and programmes (hereinafter: Government Decree on SEA).

The environmental assessment can be implemented simultaneously with the programme, therefore, it is suitable for the reinforcement of consideration of environmental criteria and finding the compromise between the different interests.

The environmental assessment is an instrument, which evolved from the environmental impact assessments (hereinafter: EIA) and has become independent. The environmental impact assessment is a process, which aims at the estimation and evaluation of some substantial changes in the condition of the environment resulting from some projected human activity and through this, it has an influence on the decision regarding the activity. (The EIA-type regulation concerns the activities manifest in the form of the investment project.)

The most important question to be decided in the course of the environmental impact assessment of plans and programmes is whether or not to consider the state of environment resulting from the projected new activity as a state acceptable for us. The level above the plans and programmes in the planning hierarchy, the strategic environmental assessments no longer apply to specific projects where the choice is between accepting or refusing the activity. In case of the sectoral development concepts, programmes, regional plans providing the basis for strategic environmental assessments and in case of other plans above the project level, the objective is to influence the method ('the how') of preparation and implementation of the plans.

At the level of strategies, the environmental protection in general means not only a system of conditions but also objectives and here the task of environmental assessments is complemented with the analysis of compliance of the environmental objectives, and the harmony between the non-environmental objectives with the environmental protection objectives.

In this case, the fundamental task of SEA is the analysis to define whether the provisions of the National Programme can appropriately solve the management of spent fuel and radioactive waste with respect to environmental protection and sustainability. Moreover, it is to be analysed whether the solutions projected guarantee that the annual radiation exposure of the employees and the population originating from all the sources does not exceed the dose limit defined in the relevant safety specifications – considering the latest and verified results of science, considering the recommendations of international and Hungarian expert organisations – as well as to reduce the radiation exposure to the lowest possible level reasonably achievable at all times. It is also to be analysed whether the maximum amount, concentration and method of emission – defined by their physical or chemical or other characteristics – of the radioactive materials which can be emitted in the environment is regulated accordingly.[1]

This is the reason why it is required to define the value order differences of the environmental protection and other policy developments. **The main objective of the protection of the environment** – both as a human effort and activity – **is the protection of natural and artificial values existing in the environment**. On the one hand, this means the sustaining of environmental condition actually existing and considered as valuable at this moment, the prevention of deterioration of condition and the restoration of the already damaged or destroyed environmental values to the possible level. The natural environment cannot be developed, therefore, the developments over and above the protection of values and restoration are no longer included among the tasks of the environmental protection, but fall under the scope of regional development and economic development. The two activities are in conflict because of the different value choice, when the plans and programmes cancel or damage the old values while creating the new values.

The fundamental objective of every development programme, plan and measure today is already the achievement of higher quality of life and sustainable economic development realised at regional level, with the retention and if necessary restoration of the environmental values.

[1] See the fundamental principles defined in Act CXVI of 1996 on atomic energy.

Therefore, also in this assessment, the definition of good quality of life is a key issue. This is generally measured in indicators of infrastructure and economy, however, based on this, it is not certain that adequate results are obtained. The state of the environment and the need for personal security are just as parts of the quality of life as the continuing possibility for existence in the community. After all, **population satisfaction can be one of the essential indicators of sustainability,** even if we know that the citizens frequently do not (or not only) focus on professional criteria in their choice of values.

In the current case, the programme to be assessed has special characteristics in comparison with other development programmes. The National Programme implements the safe management and final disposal of low and intermediate-level radioactive waste and the interim storage of the spent fuel through the use, extension and development of already existing facilities. The further steps of management of the spent fuel must be defined by means of comparative safety, technical and economic analyses by the early 2040s, i.e., decision must be made about the back-end of the nuclear fuel cycle based upon the recycling feasibility of the fission material. In case of the power generation reactors, several scenarios can be proposed for the back-end of the nuclear fuel cycle, the implementation of which is feasible under step-by-step decision-making, therefore, the concrete items of the solutions at this time cannot be included in the National Programme and the SEA. The scenarios formulated in the Programme are compared and evaluated by the SEA.

As mentioned in the National Policy, based on regular public opinion polls residents in the vicinity have a favourable attitude toward the existing and operating radioactive waste management and final disposal facilities.

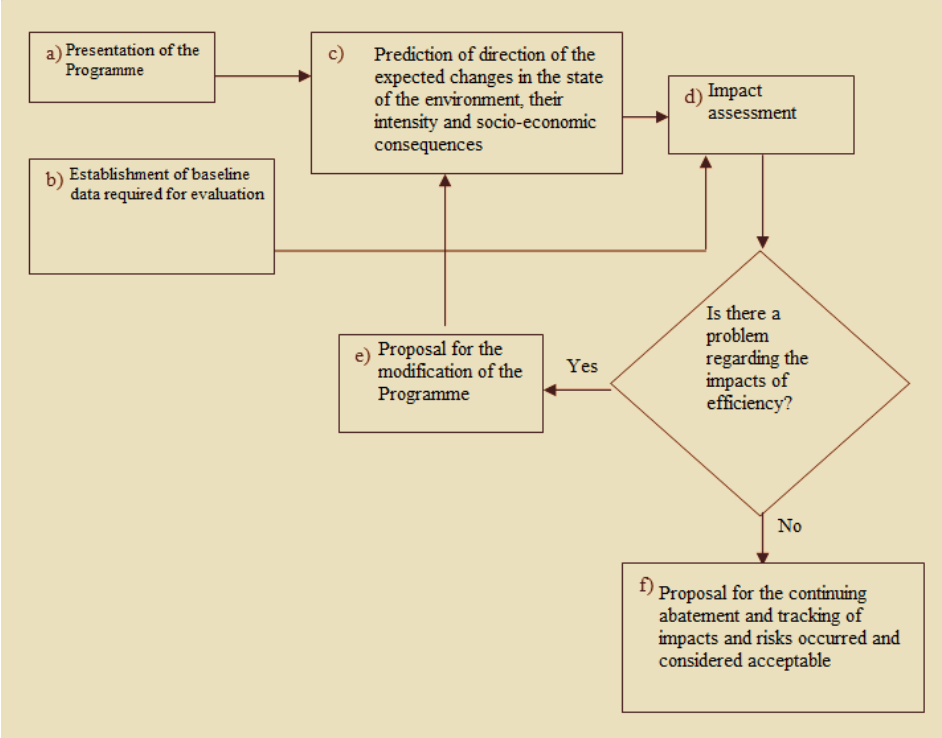
Information policy and establishing the independent control options for the host regions have a significant role in establishing the confidence of the population.

1.3. Terms of reference of the environmental assessment and the method applied

1.3.1. Process of the environmental assessment

The basic logic of the environmental assessments and work process of impact assessments is presented in ***Figure 1-1***.

Figure 1-1 **Main sub-processes of the environmental assessment**



The work stages of the current environmental assessment are defined under the figure as follows:

a) Presentation of the National Programme
b) Establishment of reference baselines required for assessment
c) Prediction of expected changes in the state of environment
d) Impact assessment
e) Proposal for the modification of the National Programme (as required)
f) Proposal for the reduction and monitoring of the unfavourable impacts/risks

1.3.2. Contents of the terms of reference agreed with the authorities

In the first step of the work, the content requirements of the applicable law, i.e., the Government Decree on SEA must be adapted specifically to the National Programme under review. The terms of reference of the work have been defined through discussion with the authorities specified by law (also see Chapter 1.8) as follows:

1. Presentation of the development process of environmental assessment

1.1. Preliminaries, elaboration of the National Programme, definition of the problem to be managed

1.2. Necessity and objective of the environmental assessment

1.3. Terms of reference of the environmental assessment and the method applied

1.3.1. Process of the environmental assessment

1.3.2. Contents of the terms of reference agreed with the authorities

1.3.3. The most important methodological criteria and specific features of the environmental assessment

1.3.4. Organisations and experts performing the environmental assessment

1.4. Denomination of connection points to the other parts of the planning process (preliminaries to the National Programme, the planning process originating from the National Policy and programme, their environmental work streams)

1.5. Source of data used for the preparation of the environmental assessment, limits of the method applied, difficulties (e.g. technical deficiencies, lack of certain information, etc.), limits of validity of forecasts, uncertainties arising

1.6. Impact of proposals made in the course of preparation of the environmental assessment on the evolution of the plan and the programme, respectively (re-entry of the items agreed with the entities developing the programme)

1.7. Participation of the entities responsible for the protection of the environment and of the public concerned, the consideration of the opinions and criteria provided by them in the course of preparation of the environmental assessment

2. Brief description of the National Programme

2.1. Summarising description of the objective and contents of the National Programme, highlighting the parts important for the preparation of the environmental assessment

2.2. Analysis of context with other relevant plans and programmes, essentially of the harmony with the National Policy

2.3. Presentation of versions (explanation of lack of versions with respect to the existing facilities, presentation of points of choice among the possible versions and presentation of their time sequence in the course of future activities)

3. Harmony of the National Programme and the objectives set at the community and national levels

3.1. The most important community (primarily EU) and national objectives related to the National Programme

3.1.1. Radiological area

3.1.2. Traditional environmental area

3.2. Environmental protection system of objectives compiled from the community and the national objectives and the National Programme

3.3. Internal consistence of the National Programme

4. Environmental impacts of the National Programme, definition and analysis of environmental risks in the specific radiological and traditional environmental protection areas

4.1. The relevant elements and other properties of the current environmental situation related to the plan and programme, the currently existing environmental conflicts and problems and their expected evolution, should the plan or programme fail to be implemented

4.2. Definition of factors (actors) and effect processes of activities planned in the National Programme leading to direct and indirect radiological and conventional environmental impacts, with particular reference to the plan elements, planned actions, which

- mean the direct use of the natural resource or directly cause the environmental exposure
- trigger or stimulate such social or economic processes, which may directly involve environmental consequences

4.3. Forecasting the radiological and conventional direct environmental impacts and environmental consequences regarding the environment and expected in case of the implementation of the National Programme
- environment use or exposure on the elements of the environment (land, air, water, flora and fauna, built environment, and as part of this latter, on the architectural and archaeological heritage)
- on the systems, processes, structure of the elements of the environment, particularly on the landscape, settlements, climate, natural (ecological) system, biodiversity
- on the state, condition and character of protected natural areas and Natura 2000 areas, as well as the possibilities of retaining, sustaining, restoration and development of the favourable nature conservation state of habitats and species in these areas
- changes expected to occur in the state of health and socio-economic situation of the people concerned – particularly in their quality of life, cultural heritage and conditions of their land use

4.4. Forecasting the factors indirectly triggering effects (if relevant), with particular regard to the following
- new environmental conflicts and problems emerging, intensification of the existing ones
- weakening or restriction of possibilities and conditions of the environmentally conscious, eco-friendly attitude and way of life
- sustaining or establishment of deviation from the optimum spatial structure, mode of land use in harmony with the local endowments
- weakening of such local socio-cultural, economic-management traditions which were adapted to the carrying capacity of the land
- restriction of renewal of natural resources
- substantial use of non-local natural resources or use of local natural resources predominantly in other areas

4.5. Possibility of cross-border effects and evaluation of their significance
- criteria of evaluation of cross-border effects
- filtering of cross-border effects
- evaluation of cross-border effects

5. Sustainability analysis

5.1. Definition of sustainable development

5.2. Definition of the sustainable value order regarding the National Programme

5.3. Sustainability analysis for the National Programme

6. Summarising evaluation of the National Programme based upon the environmental and sustainability consequences

6.1. Consideration of the environmental and sustainability criteria in the National Programme

6.2. Summarising evaluation of the combined impacts of implementation of the National Programme, comparative environmental and sustainability priorities in case of the long-term versions and decision-making points (if this is possible in the current stage)

7. Recommendations: possibility of integrating the results of the environmental assessment in the National Programme

7.1. Recommendations for the mitigation of unfavourable effects and for the improvement of environmental and sustainability efficiency of interventions

7.2. Recommendation to be taken into account in other plans and/or programmes affected by interventions

7.3. Recommendations for the monitoring of expected environmental effects

8. Non-technical summary

Naturally, the details of the individual items in the terms of reference substantially depend on the characteristics of the programme under review at any time. In the actual case, the radiological effects and the state of environment of the existing facilities will be given a greater emphasis as current condition. The character of impact forecast also differs from the usual approach, as in this case, the forecast can be compiled from the values of the existing facilities measured in the course of emission and environment assessments as well as the data defined in the course of safety evaluations and inspections. (I.e. this document may include a more concrete presentation of effects than the more general SEA predictions.)

1.3.3. Tasks of the environmental assessment and its more substantial methodological aspects

In the course of environmental assessment, the National Programme is reviewed also from the aspect of sustainability and environmental protection. (With this, the expected requirements of the Government Decree on SEA is also expanded with the sustainability evaluations.) Fundamental question(s) are defined while drawing up the SEA – as a well-tested element of methodology –, with answers to be given upon completing the work. In case of the National Programme of spent fuel and radioactive waste management, the following questions are to be answered:

By applying the waste management solutions included in the Programme

- do we have a match to the waste hierarchy (prevention; recycling; reduction of quantity and hazard of waste to be disposed or landfilled)?
- are undesirable environmental and sustainability impacts expected, do the (radioactive and conventional) emissions and exposure into the specific environmental elements/systems change and if they do, in what direction?
- is the management of the potential disasters solved at the appropriate level?
- can safety be sustained and monitored over the long-term in case of final disposal?
- is the liveability of the regions accepting the facilities and satisfaction of the population going to change?[2]
- will the proposed solutions reduce the exposure passed on to the future generations by the appropriate rate or do they promote the implementation of the 'polluter pays' principle?
- is the protection of environment and human health ensured properly within and outside the national boundaries both in the present and the future?

[2] The concept of liveable community is related to the name of Jahn Gehl (one of the most recognised urban architects of our time). Total set of factors at the local level of liveability, which define the quality of life of the local population. Liveability is, in general, analysed according to five criteria: stability, health care, culture and environment, education, infrastructure.

In the course of the environmental assessment, additional tasks are set:

- promoting the harmonisation of the objectives of the National Programme to the targets of the European Union (EU) and Hungary related to environmental protection and sustainable development;
- analysis of efficiency and efficacy of the proposed measures, and where alternatives are identified, their comparison on the environmental and sustainability basis;
- reinforcement of favourable impacts arising when the measures are implemented, the disclosure of eventual short- and long-term environmental and sustainability risks;
- elaboration of proposals for the elimination and abatement of the risks arising.

Based upon the EU and national requirements, we also have such general criteria, which we wish to enforce in general, i.e., regarding all the plans and programmes. All the plans and programmes should be expected:

- not to restrict biodiversity and ecosystem services,[3]
- must promote adjustment to climate change,
- must be in harmony with the Water Framework Directive[4] and the Watershed Management plan serving its implementation in Hungary[5],
- it should not increase the harmful social and regional inequalities, what is more, if possible, it should *a priori* decrease them,
- it should contribute to the strengthening of social solidarity.

The results expected from SEA in general can be divided into two main parts:

- On the one hand, from environmental aspect they should qualify the new environmental situation evolving in the wake of the National Programme and create an opinion on the environmental and sustainability performance of interventions;
- On the other hand, they should help in finding the adequate solutions with respect to the environment, the risk of which may not be greater than the socially accepted risk of other activities.

The solutions included in the Strategy/Programme, **exactly because of their strategic character, are not required to meet a system of limit values** (this would not even be possible due to the lack of specificity), **but they should comply with certain well-defined (regulatory, strategic, etc.) principles, priorities and objectives.** Lacking a system of conditions integrating these principles, priorities, objectives, the changes cannot be evaluated as the basis

3 Ecosystem services are such goods and services of the flora and fauna, which humans directly or indirectly consume during their life, therefore, their state define the quality of human life. Four fundamental types of services: We directly use the goods provided by the **providing** service, they are e.g., foodstuffs, drinking water, timber and fibrous materials. The **regulatory** functions of the flora and fauna may include climate regulation, flood control, water cleaning and production of soil. **Sustaining** services include primary production (through the photosynthesis of green plants), the biological role included in the cycle of elements of water. **Cultural** services of the flora and fauna are diverse, they include substantial aesthetic, spiritual, educational and recreation functions. *(Katalin Török: A föld ökológiai állapota és perspektívái, Magyar Tudomány [Ecological state and perspectives of the Planet Earth, Hungarian Science])*

4 Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for the Community action in the field of water policy (entering into force on 22 December 2000)

5 Government Decree No. 221/2004 of 21 July 2004 on specific rules of watershed management

of comparison would be missing. It is, therefore, necessary to establish the **system of conditions for environmental protection** (baseline for comparison), with the three pillars as follows:

- **Relevant environmental policy objectives in Hungary and the EU:** The environmental policy objectives can also be interpreted as 'external factors'. Not only the implementation of the objectives of Hungary but also of the EU environmental policy represent a system of conditions (through legal regulations, specifications), through which it is required and necessary to implement the development efforts. The SEA investigates whether these objectives and the National Programme are in harmony.
- **Value system of sustainability:** With the definition of the sustainability criteria a general system of criteria has been provided, which can be applied as one kind of a planning requirement in the course of the environmental evaluation. The sustainability criteria define the criteria, which establish the basis for the sustainable socio-economic processes, also including behaviour. In the course of the work, the general principles are transformed in accordance with the National Programme under review, more precisely, it is defined whether or not the individual criteria can be applied and if so, how can they be taken into account in the course of implementation of the measures under review. In the course of the process of making the items more concrete, some general criteria regarded as non-relevant, can even be neglected.
- **Environmental problems**, their causes and consequences: The SEA identifies the expected environmental impacts and impact processes of the planned solutions expected. It predicts the character of the expected environmental state changes.

  Because in this programme, the point is, in actual fact, the continuing use, extension, development of facilities essentially existing[6], it is also possible to analyse the observation of the numerical limit values and the possibility of their observation. (This can be conducted by the current environmental analysis from the authority and independent measurements taken in the neighbourhood of the existing facilities, based upon its environmental performance evaluations and review documentations. No new measurements are taken in the framework of this work.)

1.3.4. Organisations and experts performing the environmental assessment

Pursuant to Section 8(1) of the Government Decree on SEA the environment assessment is made by the expert having the authorisation of professional expert in the specialised and sub-areas – based upon the legal regulations related to the professional activities in environmental protection, nature conservation and landscape protection.

In the current case, the (strategic) environmental inspection is conducted by ÖKO Zrt. and Golder Associates (Hungary) Zrt., with the key data as follows:

ÖKO Pte. Ltd. for Environment, Economics, Technology, Commerce, Services and Development

- Address: H-1013 Budapest, Attila út 16.
- Mailing address: H-1253 Budapest Pf. 7.
- Company register number: 01-10-041696
- Telephone/Fax: +36 1-212-6093
- Chairman-Chief Executive Officer: Dr. Sándor Ress

[6] Radioactive Waste Treatment and Disposal Facility in Püspökszilágy (RHFT), the National Radioactive Waste Repository in Bátaapáti (NRHT), and the Interim Spent Fuel Storage Facility in Paks (KKÁT).

Golder Associates (Hungary) **ZRt.**:

- Address: H-1021 Budapest, Hűvösvölgyi út 54.
- Company register number: 01-10-046550
- Telephone/Fax: 394-0005, 394-0002
- CEO: Éva Szerencsésné Miltényi

The experts of ÖKO Zrt. and Golder Zrt. participating in the work are listed in the table below (see ***Table 1-1***):

Table 1-1 **Experts participating in the environmental assessment**

Name	Membership ID No. in the Hungarian Chamber of Engineers	No. of the licence verifying authority	Function to be fulfilled in the SEA
Experts of ÖKO ZRt.			
Tibor László	-	Sz-038/2011 (SZTV), Sz-038/A/2011 (SZTjV)	nature and landscape protection
Emőke Magyar	01-7928	01-675/2014 (KÉ-Sz), 648/2/01/2014 (SZKV-1.1.), 649/0/01/2014 (SZKV-1.4.), Sz-033/2009 (SZTV, SZTjV)	desk officer (in charge of management and coordination tasks in the convention environmental protection area)
István Nagy	01-1361	4118/2010 (VZ-T, SZÉM 3., SZÉM 8., SZKV-1.1., SZKV-1.3., SZVV-3.1., SZVV-3.2., SZVV-3.5., SZVV-3.4., SZVV-3.10., SZB), Sz-100/2010 (SZTjV)	water, hydro-geology
Márta Scheer	-	Sz-089/2010 (SZTV)	nature and landscape protection
Norbert Szőke	-	Sz-078/2010 (SZTV, SZTjV)	protection of geological values, landscape protection
dr. Endre Tombácz	-	without expert authorisation (economist)	sustainability and socio-economic evaluation
Bianka Vidéki	01-14461	2562/2012 (SZKV-1.1., SZKV-1.2., SZKV-1.3., SZKV-1.4.), 067/2014 (SZTV)	conventional environmental elements, noise and vibration
Experts of Golder Associates (Magyarország) ZRt.			
Zoltán Bőthi	-	without expert authorisation (geologist, radiological qualification of extended degree)	geology, radiological impacts, safety evaluation of radioactive waste storage facilities
Gyula Dankó	13-6071	477/2013 (GT-T, VZ-T, SZVV-3.10., SZVV-3.1., SZVV-3-6., SZGT, SZÉM3)	geology, radiological impacts
Viktor Kunfalvi	13-7834	VZ-Sz; KB-T; 1215/2/0112014 (SZKV-1.1.), 1216/2/0112014 (SZKV-1.2.), 1217/2/01/2014 (SZKV-1.3.) 1218/2/0112014 (SZVV-3.10.), 01-1063/2014 (SZÉM 3.)	water, hydro-geology, convention and radioactive waste
Tamás Takács	01-2950	2094-2379/2012 (NSZ-11) independent technical expert in the specialised field of radiology	deputy desk officer (management and coordination tasks in the field of radiology)

Our experts are included in the register of the Engineer's Chamber, their certificates confirming their authorisation are attached in **Annex 1**.

1.4. Points of connection to other parts of the planning process

The National Policy defined by the Act on Atomic Energy (Act CI of 2013 amending Act CXVI of 1996) and the 'Council Directive 2011/70/Euratom of 19 July 2011 establishing a

Community framework for the responsible and safe management of spent fuel and radioactive waste' can be considered as the preliminary document to the National Programme. This was adopted by the Hungarian Parliament by its Resolution No. 21/2015 of 4 May 2015 'On the national policy of spent fuel and radioactive waste management'.

The National Programme intends to implement the radioactive waste management through the operation, expansion and technology development of existing facilities. (The high level waste and the interim spent fuel storage facility of the new blocks are exceptions.) Therefore, planning process is expected in this area only in connection with expansion and technological modification. These modifications are subject to the implementation of environmental impact assessment procedure if 'they achieve the criterion of significant modification defined in Section 2 of the Government Decree No. 314/2005 of 25 December 2005 on the licensing procedure on environmental impact assessment and the unified procedure for permitting the use of the environment (e.g. if their area or holding capacity grows by 25% or a new type of emission is generated due to the technological development or the emission subject to a limit value increases by 25 %) and the earlier licence did not include these changes.

With respect to spent fuel management, the site selection of a deep geological repository (DGR) is planned for the first 5-year planning period of the National Programme. I.e., the Stage I of Surface Exploration must be closed, and the plan for Stage II of Surface Exploration must be prepared on the basis of the results of the former stage. The construction of underground research laboratory (2030-2040), the operation of the underground research laboratory (2040-2055) may take place only after the conclusion of the exploration plan, and after the mid-2050s the storage facility can be built. Such planning processes can be connected to these phases, which also include environmental protection procedures. The preparation of environmental work streams for facilities of such size is time consuming, therefore, it is important to start these works minimum 2-3 years before the planned date of obtaining the licence, however, if possible, the baseline data should be recorded 5 years before the said date.

1.5. Source of data used for the environmental assessment

Fundamentally, the relevant EU guidelines, the national legislation, programmes, plans as well as previous licensing documentation and reports related to the existing facilities were used during the drawing of the SEA.

- Hungary's National Programme for the management of spent fuel and radioactive waste (July 2015)
- National Nuclear Research Programme (http://mta.hu/mta_hirei/elindult-a-nemzeti-nuklearis-kutatasi-program-mta-ek-nkfi-alap-136735)
- Europe 2020 – A strategy of smart, sustainable and inclusive growth (http://eur-lex.europa.eu/ LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:HU:PDF)
- Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 'Living well, within the limits of our planet' (Source: http://moszlap.hu/uploads/files/ kornyvedcselprogrhat.pdf)
- Review of the sustainable development strategy of the EU - The renewed strategy 10117/06 of the Council of the European Union (Source: http://register.consilium.europa.eu/doc/srv?l= HU&f= ST%2010117%202006%20INIT)
- National concept of the transition towards sustainability - National Sustainable Development Framework Strategy 2012-2024 (Source: http://www.nfft.hu/dynamic/NFFS_rovid_OGYhat _melleklete _2012.05.16_vegso.pdf)

- National Environmental Protection Programme (Source: http://20102014.kormany.hu)
- National Waste Management Plan 2014-2020. (Source: nkfih.gov.hu/ download.php?docID =28337)
- National Development 2030 - National Development and Regional Development Concept and National Master Plan (Source: http://www.terport.hu/webfm_send/4204)
- Report on the operation of the National Radioactive Waste Repository (hereinafter: NRHT) in 2011, BA/0025-001/2012 (February 2012)
- Assessment results of environmental impacts of radioactive waste disposal facilities, RHK Kft. (Public Limited Company for Radioactive Waste Management – Radioaktív Hulladékokat Kezelő Közhasznú Nonprofit Korlátolt Felelősségű Társaság) (http://www.rhk.hu/wp/wp-content/uploads/2011/04/kornyezeti-eredmenyek-2010.pdf)
- Definition of origin of tritium leaks at the Radioactive Waste Treatment and Disposal facility (hereinafter: RHFT) in Püspökszilágy, Isotoptech Zrt., 2004.
- More exact definition of the place of source causing tritium pollution in the storage area of RHFT in Püspökszilágy, Isotoptech Zrt., 2005.
- Environmental monitoring inspection of RHFT in Püspökszilágy in 2012, MTA ATOMKI, 2013.
- Immission data of the National Air Pollution Monitoring Network (www.levegominoseg.hu)
- Analysis of environmental effects of RHFT in Püspökszilágy – Final Report (ETV-Erőterv Rt., 2005.)
- Preparation of documentations related to the establishment licensing of storage facility for the final reposition of low and intermediate-level waste of nuclear power plants – final reposition of low and intermediate-level waste of nuclear power plants planned in the deep geological repository planned in the region of Bátaapáti – Environmental Impact Assessment (ETV-Erőterv Zrt., 2006.)
- Building new nuclear power plant units on the Paks site, environmental impact assessment, MVM ERBE ENERGETIKA Mérnökiroda Zrt. 2013.
- Data of the National Meteorological Service (www.met.hu)
- Results of the project PRUDENCE (www.prudence.dmi.dk)
- IPCC: Climate Change 2013 The Physical Science Basis; Working group I contribution to the Fifth Assessment Report of the IPCC
- Judit Bartholy, Rita Pongrácz, 2014: IPCC AR5 Facts and vision, global and regional changes
- IPCC: Climate Change 2014 Synthesis Report, The Fifth Assessment Report
- NIPCC, 2014: Climate change II Reconsidered, Biological Impacts
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- Amendment of Bátaapáti Municipal Master Plan of the Mayor's Office of Bátaapáti Municipal Administration adopted by the Resolution No. 12/2010 of 9 March 2010 of the Local Government of Bátaapáti
- The plan established by the Resolution No. 2/2003 of 12 February 2003 of the City Council of the local government of the city of Paks, amended and recast in an integrated document by the Resolution No. 79/2011 of 23 November 2011 of the City Council of the local government of the city of Paks as the Plan for Urban Structure of the city of Paks
- Comprehensive review of emission limit values of the Püspökszilágy RHFT (RHK-I-013/14, December 2014)
- Operational safety report as a basis for the continuing operation of the interim storage facility of RHFT (RHK–I–001/14, March 2014)
- Long-term safety assessment as basis for the continuation of safety enhancement programme of the Püspökszilágy RHFT (CNBGA00001D000, July 2010)
- Annual reports on the operation and safety of the Interim Spent Fuel Storage Facility (hereinafter: KKÁT) (RHK Kft.)
- Performance evaluation for the renewal of operation licence of KKÁT (NPA85O01E0100O, October 2014)
- Building new nuclear power plant units on the Paks site, Environmental Impact Assessment, management and disposal of radioactive waste and spent fuel (MVM Paks II. Zrt.)
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1.6. Limits of the testing method, validity boundaries and uncertainties of forecasts

The radioactive waste repositories operating in Hungary have environmental protection, establishment and operation licences. The repositories organise and perform their environmental control and emission monitoring activities in accordance with the Environment Control Regulations and Emission Monitoring Regulations approved by the authority with jurisdiction. Before establishment and commissioning into service, the so-called baseline values, the limit values before operation were defined in the most significant points in the environment of the storage facilities. The results of control measurements are also compared to these data, which are taken regularly each year according to a programme and which are documented in the annual reports as specified in the licences issued by the authority.

In case of operating facilities (NRHT, RHFT, KKÁT) not the impacts of a projected facility needs to be predicted, but the specific environmental impacts of existing sites must be evaluated. The use of detailed environmental control and emission monitoring data allow the reliable recording of the environmental baseline condition and the estimation of environmental impacts, reducing uncertainties to the minimum.

The National Programme defines decisions to be made in the future regarding the planned projects (final repository of high activity waste, new Interim Spent Fuel Storage Facility), which will or may substantially influence the design, capacity, location of the planned storage facilities, therefore greater uncertainties are embedded in the forecasts regarding these facilities.

1.7. Impact of proposals made in the course of preparation of the environmental assessment on the evolution of the National Programme, respectively (re-entry agreed with the entities developing the programme)

To be drawn up after completing the social participation procedure.

1.8. Participation of the entities responsible for the protection of the environment and of the public concerned, the consideration of the opinions

Pursuant to the provisions of Section 7(1) of the Government Decree on SEA, the entity developing the document seeks the professional opinion of the agencies in charge of the protection of the environment in order to define the substantive contents and details of the environmental assessment (hereinafter: terms of reference). In this particular case, the SEA terms of reference for the National Programme was completed in October 2015. The Department of Nuclear Energy of the Ministry for National Development (hereinafter: NFM) responsible for drawing up the National Programme submitted without delay to the agencies responsible for the protection of the environment defined in the Government Decree on SEA. The deadline for returning the opinions was set as 7 December 2015. Professional opinions were received until 14 December 2015 from the agencies responsible for environmental protection as follows:

- Ministry of Agriculture, State Secretariat responsible for Legal and Administration Affairs (FM)
- Ministry of the Interior, National Directorate General for Disaster Management (BM OKF)
- National Inspectorate for Environment, Nature and Water (OKTF)
- Hungarian Atomic Energy Authority, Department for Foreign Relations, Euratom and Legal Affairs (OAH)
- Prime Minister's Office: Deputy State Secretariat for Building and Construction Affairs (ME)

The terms of reference have not been commented by the NFM, Department of Energy Management and Mining, the Ministry of Human Capacities and ÁNTSZ (National Public Health Service) Office of the National Medical Officer General.

From among the agencies submitting comments, FM primarily defined expectations regarding the mode of implementation of the procedure. Detailed observations have been submitted

regarding the terms of reference by OAH, of which the relevant findings were entered in the terms of reference of the SEA. Pursuant to the provisions of Section 7(5) of the Government Decree on SEA, the terms of reference agreed with the agencies in charge of the protection of the environment, the SEA timetable and the planned method for public information and seeking observations from the general public were sent to the entities responsible for the protection of the environment and they were also published on the government website by NFM on 28. December 2015. (http://www.kormany.hu/hu/dok?type=302#!DocumentBrowse)

There is an important finding related to social participation, which must be noted early on in the analysis. In the course of the debates related to the use of nuclear energy, the environmental protection NGOs and individuals primarily dispute the environmental and sustainability features of the use of nuclear energy and consider it as a solution to be refused. However, they almost totally ignore the point, that if a system like this already exists, how should it be operated and managed in the most eco-friendly and sustainable manner possible. The task of the professionals preparing the SEA was the analysis of the National Programme regarding the management of spent fuel and radioactive waste, our mandate does not include the taking of a position in the dispute going on about the basic question. The SEA investigates the compliance of activities defined in the National Programme, therefore, we can answer questions restricted to this scope only in the course of social participation.

The remaining work stream of the chapter will be completed after the procedure of social participation is completed.

2. DESCRIPTION OF THE NATIONAL PROGRAMME

In the course of the summarising presentation of the National Programme, the parts important for the preparation of the environmental assessment are highlighted in accordance with the expectations of the Government Decree on SEA.

2.1. About the National Programme

2.1.1. EU requirements regarding the National Programme

Article 4 of the relevant EU Directive requires the Member States to work out and maintain national policies for the management of spent fuel and radioactive waste. Pursuant to the requirement above, the Hungarian Parliament by its Resolution No. 21/2015 of 4 May 2015 adopted the document on the national policy for the management of spent fuel and radioactive waste.

The National Policy provides a summary of the fundamental principles to be applied for the management of spent fuel and radioactive waste Most of these fundamental principles were also included in the Hungarian legal regulations – primarily in the Act CXVI of 1996 on atomic energy and its decrees for implementation - even before the National Policy had been adopted, however, they were also summarised in a systematic manner in accordance with the stipulations of the Directive. In addition to the presentation of the current state (regulatory and institutional frameworks, waste classification rules, etc.), the National Policy defines the boundary conditions of the policy regarding the back-end of the fuel cycle, the radioactive waste management and the decommissioning of nuclear facilities, moreover, the requirements and methods of public participation in the decision-making process, i.e., the policy of providing publicity are also manifest. The National Policy provides a basis also for the preparation of the National Programme, which defines the method of implementation of the objectives defined in the National Policy.

In its Article 11, the Directive specifies for each country to have a National Programme which must be updated regularly. By considering Article 12 of the Directive, the National Programme completed includes the following:

(a) the overall objectives of the Member State's national policy in respect of spent fuel and radioactive waste management;

(b) the significant milestones and clear timeframes for the achievement of those milestones in light of the over-arching objectives of the national programme;

(c) an inventory of all spent fuel and radioactive waste and estimates for future quantities, including those from decommissioning, clearly indicating the location and amount of the radioactive waste and spent fuel in accordance with appropriate classification of the radioactive waste;

(d) the concepts or plans and technical solutions for spent fuel and radioactive waste management from generation to disposal;

(e) the concepts or plans for the post-closure period of a disposal facility's lifetime, including the period during which appropriate controls are retained and the means to be employed to preserve knowledge of that facility in the longer term;

(f) the research, development and demonstration activities that are needed in order to implement solutions for the management of spent fuel and radioactive waste;

(g) the responsibility for the implementation of the national programme and the key performance indicators to monitor progress towards implementation;

(h) an assessment of the national programme costs and the underlying basis and hypotheses for that assessment, which must include a profile over time;

(i) the financing scheme(s) in force;

(j) a transparency policy or process as referred to in Article 10;

(k) if any, the agreement(s) concluded with a Member State or a third country on management of spent fuel or radioactive waste, including on the use of disposal facilities.

The primary objective of the National Programme – in addition to the fulfilment of fundamental principles and boundary conditions stipulated in the National Policy – is to present the plans, technical solutions and financing of the management of all the spent fuel and radioactive waste generated on the territory of the country, from the moment of production until final disposal.

2.1.2. Fundamental principles for elaborating the National Programme

The National Programme was elaborated by considering the fundamental principles as follows:

- **Protection of human health and the environment**: Nuclear energy can be used only in a way which presents no danger to human life, the health, living conditions of the present and future generations, the environment and the material goods over and above the socially acceptable risk levels, necessarily undertaken also in the course of other activities. A general condition to the application of nuclear energy is, that the social advantages it provides, should be greater than the risks threatening the population, the employees, the environment and the material goods.
- **Supremacy of safety:** Safety has the supreme priority over and above any other requirements in the course of application of nuclear energy, i.e., the activities being the subject of the National Programme (management of radioactive waste and spent fuel as well as decommissioning of nuclear facilities).
- **Abatement of the burden passed onto future generations:** In the course of applying nuclear energy, the safe management of the produced radioactive waste and spent fuel must be secured so that no burden heavier than acceptable is passed onto the future generations.
- **Minimising the production of radioactive waste**: The user of nuclear energy must take measures to reduce the amount of radioactive waste generated in the course of its activities to as low as reasonably achievable.
- **ALARA principle**: An acronym of 'As Low As Reasonably Achievable', which means the keeping of radiation exposure at a level which is as low as reasonably achievable.
- **Final disposal of radioactive waste produced in Hungary**: The radioactive waste produced in Hungary as well as the high level radioactive waste resulting from the processing of spent fuel generated in the course of fuel use in Hungary, must be essentially disposed in final repository facilities in Hungary. An exception to this rule can be the case if there is an agreement in effect at the time of delivery with a country undertaking final disposal – considering the criteria defined by the European Committee – under which the radioactive waste produced in Hungary can be transported to the radioactive waste repository of the country concerned for the purposes of final disposal.
- **The 'polluter pays' principle**: The costs of management of spent fuel and radioactive waste must be incurred by the entity producing these materials.

2.1.3. The frameworks defined

The National Programme clearly defines that **the ultimate responsibility shall be borne by the Hungarian State regarding the management of the spent fuel and radioactive waste produced in Hungary.** At the same time, the primary responsibility for safety shall rest with the facility, which causes the increase of risk resulting from radiation or the licence holder of the activity.

The Hungarian Atomic Energy Authority (hereinafter: OAH or atomic energy supervisory body) has been founded in Hungary as an authority supervising the nuclear facilities and the radioactive waste disposal facilities, being independent of the public administration agencies interested in the promotion and development of the application of nuclear energy. In accordance with the requirements of the Act on Atomic Energy, the agency designated by Government must be in charge of the elaboration of the national policy and National Programme for the management of radioactive waste and spent fuel, the final disposal of radioactive waste, the interim storage of the spent fuel, the back-end of the nuclear fuel cycle and the decommissioning of nuclear facilities. Authorised by the Government, OAH founded the Public Benefit Company for Radioactive Waste Management to carry out the tasks above on 2 June 1998, which was transformed into the Public Limited Company for Radioactive Waste Management (hereinafter: RHK Kft.) on 7 January 2008.

Pursuant to the Act on Atomic Energy, the Central Nuclear Financial Fund (hereinafter: the Fund) was set up, which acts as a segregated state financial fund to finance the tasks related to the management of radioactive waste and spent fuel as well as decommissioning of nuclear facilities. Amounts deposited by the Paks Nuclear Power Plant in the Fund may be allocated only to the financing of these activities, and thereby the principle that this generation does not pass unreasonable challenges to the future generations is met. The National Programme defines the amount of spent fuel and radioactive waste produced up to this date and the amount expected to be produced in the course of activities of the currently operating and planned nuclear power plants as well as other activities involving the generation of radioactive waste. In accordance with the stipulations of the National Programme, the existing facilities are suitable for the management of radioactive waste.

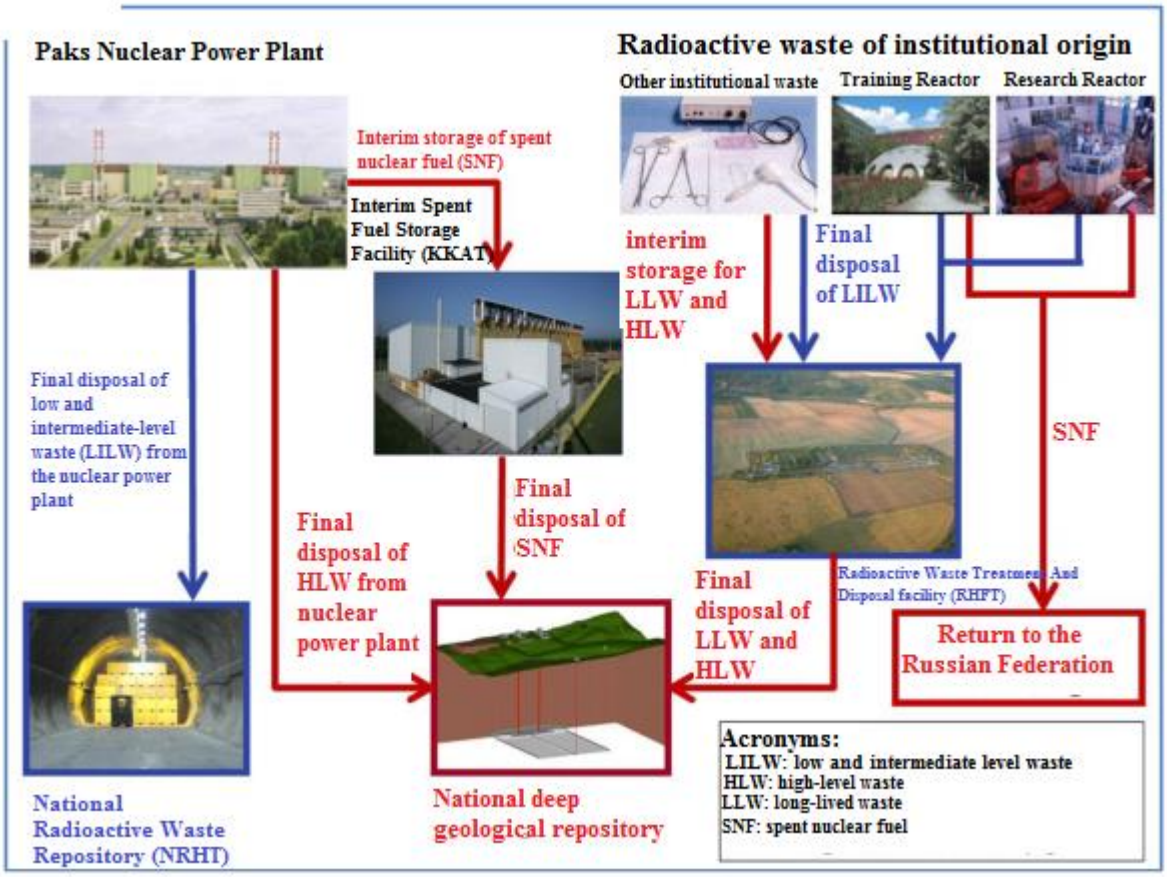
Any new facility is considered in the case of the interim storage of high level and the very low level waste as well as the spent fuel of the new blocks. The operation and technological development and, if necessary, the expansion of the Radioactive Waste Treatment and Disposal Facility (hereinafter referred to as the RHFT) of Püspökszilágy, the Interim Spent Fuel Storage Facility (hereinafter referred to as the KKÁT) of Paks as well as the National Radioactive Waste Disposal Facility (hereinafter referred to as the NRHT) of Bátaapáti are suitable for the processing of the wastes generated in the future, for the treatment and final disposal of their volumes.

The nuclear facilities in Hungary and the location of facilities taking part in the management of radioactive waste in Hungary are shown in ***Figure 2-1***. The logic scheme of management of spent fuel and radioactive waste is summarised by the National Programme according to ***Figure 2-2***.

Figure 2-1 **Nuclear facilities and plants taking part in the management of radioactive waste and their location**

Source: National Programme

Figure 2-2 **Logic scheme of management of spent fuel and radioactive waste management**



Source: National Programme

2.1.4. Production and classification of radioactive waste

Radioactive materials are used related to the most diverse activities. However, it is generally preferable to consider them classified into a few groups in accordance with their use:

- The most widely known and most significant area of application of nuclear energy is the generation of electricity. At present, 4 reactor units of the Paks Nuclear Power Plant are in operation in Hungary, supplying about 36% of the electricity demand jointly.
- Radioactive materials and ionising radiation are used in the field of medicine, both for diagnostics and therapy.
- Radioactive materials are also applied in several fields of industry and agriculture (e.g., sterilisation, detection of material faults).
- Moreover, radioactive materials are used and produced, respectively, in the research and training reactors operated for the purposes of research and education, e.g., the Research Rector of the Hungarian Academy of Sciences Centre for Energy Research, as well as the Training reactor of the Institute of Nuclear Techniques of the Budapest University of Technology and Economics (hereinafter: BMGE).

Radioactive waste is produced in each of the applications listed above. Based upon the definitions in the Act on Atomic Energy, radioactive material is considered radioactive waste when the material is no longer

radioactive waste is the name of such radioactive materials not destined for further use, which cannot be treated as common waste owing to their radiological properties, i.e., it cannot be liberated and the individual annual radiation dose deriving from its related management as non-radioactive waste exceeds the effective dosage of 30 μSv.

Radioactive waste can be classified (regardless of their form) based upon the activity[7] and typical half-life of the isotopes included as follows.

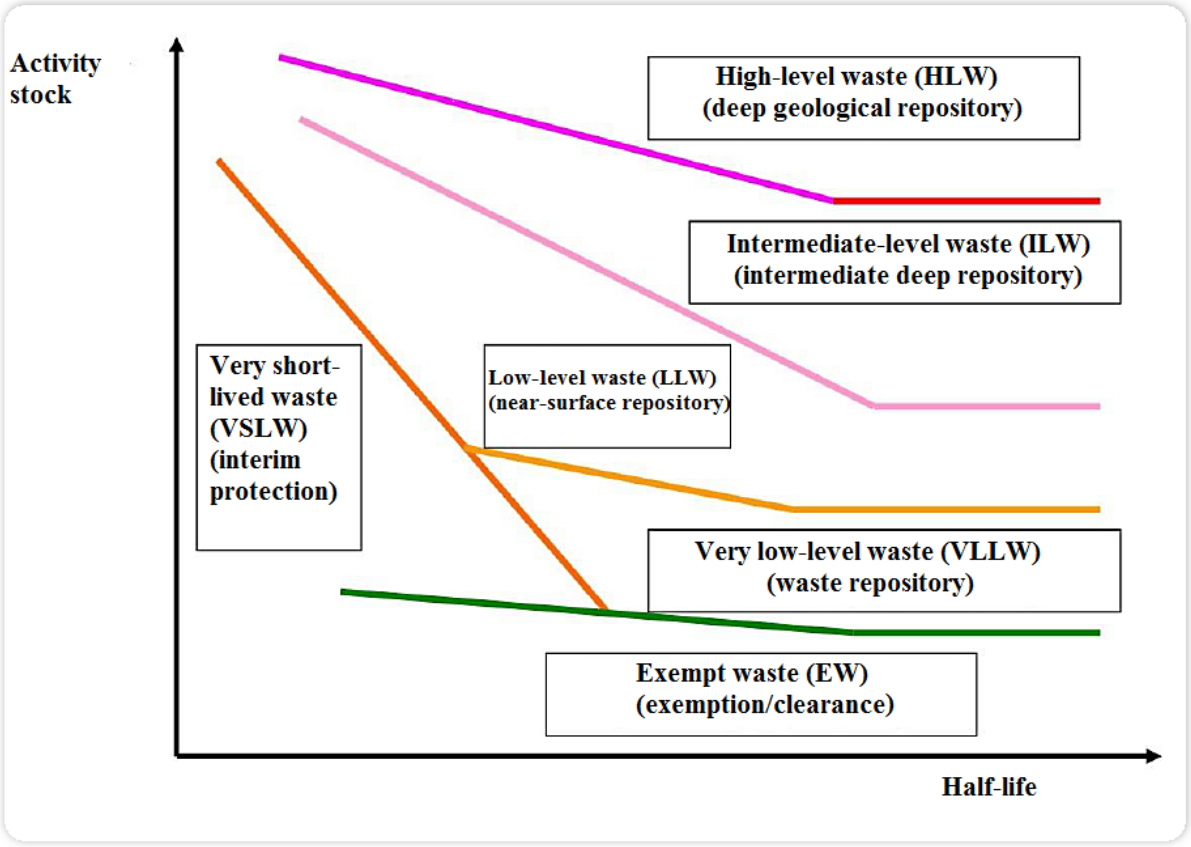
- The radioactive waste is classified as low and intermediate-level radioactive waste in which the heat generation is negligible in the course of disposal (and storage).
  - Short lived low and intermediate level radioactive waste are those that contain radionuclides with a half-life of 30 years or shorter and contain only a limited concentration of long lived alpha-emitting radionuclides.
  - Long lived low and intermediate level radioactive waste are considered those for which the half-life of the radionuclides and/or the concentration of alpha-emitting radionuclides exceeds the limit values applying to the short lived radioactive waste.
- High level radioactive waste is radioactive waste, the heat generation of which must be taken into consideration in the design and operation of storage and disposal.

The concept scheme of classification, management and storage of radioactive waste is shown in the ***Figure 2-3*** below.

The Hungarian regulations in effect do not include at present the very low-level waste (VLLW)[8] class, studies have already been conducted for the preparation of the eventual introduction of this class.

[7] Classification is performed based upon the so-called waste index calculated from the activity concentrations of the radioactive isotopes and the total of quotients of their decontamination activity concentrations.

Figure 2-3 **Concept scheme of classification of radioactive waste**



2.1.5. Management of radioactive waste

This chapter reviews the radioactive management processes applied in the specific institutions and facilities. The presentation is classified according to the character of the facilities:

(a) Management of (institutional) waste related to industrial, agricultural and medical activities;

(b) Management of waste originating from the operation of research and training reactors;

(c) Management of radioactive waste produced at the Paks Nuclear Power Plant and the Interim Spent Fuel Storage Facility (KKÁT);

(d) Management of waste supplied to the radioactive waste storage facilities.

The institutional radioactive waste is typically produced in hospitals, laboratories and industrial companies in the form of low and intermediate-level waste, spent radiation source and radiation source removed from smoke detectors. Management of (institutional) waste related to industrial, agricultural and medical activities is implemented in the first stage on the site of the licence holder (the user of the radioactive substance). Almost in each case, this is restricted to interim storage and for the preparation of transport to the RHFT operated by RHK Kft. The licence holders hand over for interim storage or for final disposal on the average 10-15 m^3 radioactive waste and 400-500 spent, self-contained radiation sources annually.

[8] According to the definition of the International Atomic Energy Agency (hereinafter: IAEA) the very low-level waste (VLLW) is such a waste, which does not meet by definition the criteria related to the liberation/exemption waste, however, which does not require efficient isolation.

Low and intermediate-level solid radioactive waste is produced in the Budapest Research Reactor during normal operation typically from two sources:

- active aluminium capsule residues in the course of isotope production;
- protective apparel contaminated during routine operations and maintenance (rubber gauntlets, shoe covers, protective clothing, etc.) as well as plastic film, filter paper.

About 2 m^3 solid radioactive waste is produced annually, which is stored in 200-litre steel barrel after manual compacting. About 100 litres of radioactive ion exchanging resin is produced on an annual average during operation, and a few m^3 sludge is accumulated at the bottom of the liquid waste collecting tanks until the end of the operating period. The radioactive waste generated in the course of operation is regularly transported for final disposal to the RHFT in Püspökszilágy.

In case of the Training Reactor of BMGE radioactive waste is produced in connection with its operation as well as in the course of operating the laboratories in the building. Solid radioactive waste can be generated through the removal of certain parts and devices of the reactor; the irradiation of specimens used for education and research, as well as their processing; in the course of using the consumables of laboratories; and the rejection of self-contained radioactive radiation sources. Annually, an average of 6 bags of solid radioactive waste is produced (maximum 100 litres per bag), with the typical mass of the bags being 3-8 kg. A significant part of the potential radioactive liquids can be discharged, therefore, just a few litres of liquid radioactive waste is produced on the average annually. Similarly to the Research Reactor, the radioactive waste generated in the course of operation is moved regularly to the RHFT in Püspökszilágy for final disposal.

High-level waste is not produced either in the course of operation or subsequent decommissioning of the Research Reactor or the Training Reactor. The spent fuel produced so far in the Research Reactor has been transported to the Russian Federation. No spent fuel is expected to be produced before the final shutdown of the Training Reactor.

The largest amount of radioactive waste is produced in the course of operation of the 4 reactor units of the Paks Nuclear Power Plant. Collection and management of the solid and liquid radioactive waste produced during the operation of the Paks Nuclear Power Plant must be taken care of.

The most important sources of low and intermediate-level solid radioactive waste is the protective garments, protective equipment, tools and plastic films contaminated during operation and maintenance; as well as the equipment, pipelines, thermal insulations, etc. removed from the operating facility, which became contaminated or activated, etc. The solid waste is collected selectively, taking into account the subsequent treatment possibilities. The solid waste is treated in general in groups classified as compactable, non-compactable or active sludge. They are put into interim storage on the site of the nuclear power plant. The low and intermediate-level waste is moved to the interim storage rooms usually in 200 litres drums, while the high level waste is stored in pipe wells.

Liquid radioactive waste is primarily produced in the course of treatment of the water in the primary circuit, the decontamination of rooms and equipment. The liquid waste of aqueous base produced in the primary circuit of the nuclear power plant is condensed after sedimentation, mechanical filtration and treatment by chemicals. The concentrate remaining after condensation (condensation residue), the spent ion exchanging resin and the evaporator acid treatment solution as well as the diatomaceous earth will be put into interim storage in segregated tanks in the controlled zone of the nuclear power plant. For the drastic reduction of volume of liquid waste, the liquid waste treatment technology (hereinafter: LWT technology) has been

commissioned in the Paks Nuclear Power Plant. Through the normal application of this technology, the evaporation residue constituting the largest fraction of the liquid radioactive waste – after the removal of cesium and cobalt isotopes, as well as the recovery of boric acid contents – will be discharged together with the other dischargeable waters produced in the primary circuit after inspection.

Relatively small volumes of high level radioactive waste is produced annually (5 m^3/year), which is placed into interim storage in pipe wells.

The operation incident of Unit 2 of the Paks Nuclear Power Plant in 2003 resulted in damaged fuel assemblies that produced radioactive waste types that are not encountered during normal operation. Significant amount of spent ion exchanging resin, evaporation residue, decontamination solution and solid radioactive waste polluted with alpha radiation isotopes were produced in the course of the management and control of the operation failure. A significant part of these waste was collected and put into interim storage separately, the LWT technology is not applied for the evaporation residue resulting from the operation failure.

The low and intermediate-level radioactive waste originating from the operation of the Paks Nuclear Power Plant is delivered to the NRHT operating in Bátaapáti.

At the site of the RHFT in Püspökszilágy, the normal operation activity includes the reception of radioactive waste, the management of waste (sorting, qualification, and conditioning), interim storage and final disposal. Normal operating activities have been expanded from the spring of 2007 with the so-called safety enhancement programme, aimed at the removal, sorting, conditioning and repeated disposing of radioactive waste, which waste was put into storage some time ago, and no longer comply with the current requirements.

The radiation sources, the nuclear material, the compactable and the non-compactable components of mixed solid waste and the liquid waste are treated separately. Spent radiation sources are repacked in the hot chamber or encapsulated into capsule for storage in wells. The waste package received or recovered in the safety enhancement programme are sorted, the compactable waste is compacted into 200-litre drums, while the non-compactable waste is placed in 1.2-m^3 steel containers filled with cement. The liquid waste is solidified by cementing.

The low and intermediate-level radioactive waste originating from the Paks Nuclear Power Plant is received by NRHT operating in Bátaapáti, with the waste transported from the power plant on road. In accordance with the current procedure, the 200 litres drums transported in a carrying frame are buffer stored in the storage area of the Technological building until they are placed in a reinforced concrete container and filled with cement for final disposal. The waste packages produced in this way are moved to the storage chamber I–K1 for final repositioning.

The planning and licensing of the thin-steel-wall waste packages projected for the site of the Paks Nuclear Power Plant – corresponding to the already introduced LWT technology – is currently under development. After licensing, the transport to NRHT will be performed already in such units and they will be put into storage in accordance with the new waste disposal concept in the reinforced concrete vault built in the chambers starting from chamber I–K2. The disposing of standalone drums is planned on top of the reinforced concrete vaults.

2.1.6. Storage and disposal of radioactive waste

The chapters below summarise the current practice and projected implementation of the storage and disposal of radioactive waste produced in Hungary in accordance with the provisions of the National Programme. The storage and disposal of radioactive waste are presented in accordance

with their level of radioactivity in the first place, and classified by the producing institutions and activities, in the second.

2.1.6.1. State of the very low-level waste

The Hungarian regulations in effect do not include at present the class of very low-level radioactive waste, however, which is part of the waste classification system of the International Atomic Energy Agency. Based upon the underlying studies conducted so far, a summary needs to be drawn up, based upon which the amendments of legal regulations can be launched as required, and the concept for the final disposal of very low-level waste can be elaborated. After the preparation of the concept, the National Programme must be expanded with this area.

Very low-level radioactive waste is primarily produced in the decommissioning operations of nuclear power plants. The estimated amount, based on international experience, is about 80 % of the total decommissioning waste in case of the currently operating nuclear power plant (units 1-4 of Paks), however, this can be even as high as 89% in case of the new units (units 5-6 of Paks). Based upon these points, considering the principle of proportionality, the optimum concept must be elaborated for the disposal of such waste under the National Programme. In the course of this work, the two radioactive waste repositories in operation today must also be taken into account. The National Programme raises the necessity to analyse the way in which the very low-level waste can be disposed in NRHT operating in Bátaapáti.

The National Programme plans to introduce this waste category with respect to very low-level waste and the elaboration of the concept for the related final disposal of waste classified in this category as well as the introduction of the required amendments to legal regulations by 2020.

2.1.6.2. Disposal of low and intermediate-level waste

The National Programme stipulates that the final reposition of low and intermediate-level radioactive waste produced in Hungary must be implemented in radioactive waste repositories established in Hungary.

Two repositories operate in this country for the final disposal of low and intermediate-level radioactive waste; the waste of institutional origin is received by the RHFT, while the waste originating from the nuclear power plant is received by the National Radioactive Waste Repository.

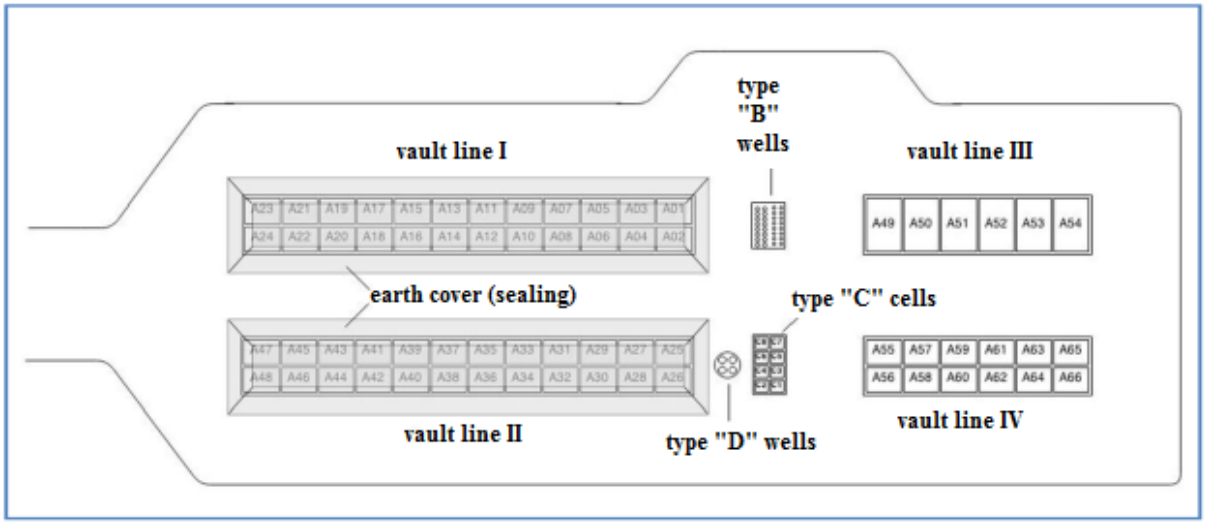
The RHFT in Püspökszilágy

The establishment of the Püspökszilágy disposal facility has become necessary due to the exploitation of storage capacities and the inappropriate design of the Solymár storage facility used in the 1960s. The operation of the new disposal facility (RHFT) started in 1970s, in accordance with the requirements of the time. In terms of engineering, the disposal facility was built with vaults and tubular wells built near the ground surface. The waste was delivered here at the very end of 1970s from the earlier Solymár repository, and, with an interim character, low-level solid radioactive waste was also transported here from the Paks Nuclear Power Plant in the periods of 1983-1989 and 1992-1996, since that time only the reception of waste of institutional origin has been permitted.

The site allows the final disposal of radioactive waste (outdoor) or interim storage (both outdoor and indoor). Waste allocated for final disposal is disposed in the 'A' type vaults (

***Figure* 2-4**). In the 'C' type vault, conditioned (solidified) organic solutions are placed (stored). The 'B' and 'D' type wells are used for the disposal of radiation sources. The service building at the basement level includes the storage facility for waste in drums and containers, the interim disposal facility incorporating the wells and the interim storage for nuclear materials and neutron sources has also been established. According to the current plans, only the waste in the type 'A' vault (1-64) must remain on-site when the repository is terminally closed, all the other waste must be transferred from the site to the repository allocated for their final disposal.

Figure 2-4 **Plant section of the RHFT facility for the final repository**



Source: National Programme

In order to make certain that the site also meets the current requirements, since its foundation, the RHK Kft., as the organisation responsible for radioactive waste management, continuously develops the technology and the safety systems. In the past 10 years, all the waste management equipment have been renewed, the buildings have been renovated and the measuring instruments have been replaced with new ones. In the course of this process, such technologies (hot cabin, sorting box, compacting press, cementing equipment) have been installed, which are necessary for the safe management of the institutional radioactive waste taken over and of the radioactive waste already disposed and retrieved.

Another area of the enhancement of safety is the review of safe disposing of waste packages placed at RHFT decades ago, which process was started in 2000 with a comprehensive assessment. The refined safety assessment conducted in 2002 verified that the operation of RHFT and the safety of the environment are guaranteed properly until the end of the institutional monitoring period and the facility is suitable for the final disposal of the institutional radioactive waste meeting the acceptance criteria (short half-life and low and intermediate-level activity). At the same time, the attention is directed to the point that after completing the institutional inspection such scenarios can be proposed as a result of which the long half-life waste disposed earlier may lead to the radiation exposure of the population in excess of the dosage limit. This state and the exploitation of capacity of RHFT have jointly resulted in the elaboration of the programme aiming at the increase of safety and liberation of capacity. As a result of this programme, it was established that the re-sorting, re-packaging and simultaneous compacting of the waste placed 30-35 years ago are inevitable steps. In the course of this latter process, storage capacity is freed, which is important because this facility will be required for an additional period of 40-50 years, for the reception of radioactive waste produced in the various institutions. One stage of the work – the demonstration programme completed in 2006-2009 covering 4 vaults – has already been completed, but the bulk of recovery of the so-

called 'historical' waste is yet to start. The results of the demonstration programme show that the intervention has been successful, both objectives have been met and the recovery of the radioactive waste was relatively simple to do, even in case of the semi-concreted vaults. Therefore, the continuation of the safety enhancement programme is planned with the application of the same methodology regarding the other vaults – assigned for retrieval.

In accordance with the National Programme, a light-weight structure hall with a crane must be constructed to continue the safety enhancement programme, which is expected to be completed by 2017. Complete waste recovery is proposed regarding 24 vaults for the vault lines I (between 2017-2022) and II (between 2023-2029), that is 48 vaults, while for 20 vaults partial waste retrieval is recommended. (4 vaults have already been processed in the demonstration programme.) In the subsequent stage of the safety enhancement programme (between 2030-2037), the contents of the vault lines III and IV must be retrieved, processed and reposited together with the elimination of the shallow storage 'C' type vault. Thereafter, the experimental construction and operation of the future final vault cover will take place (in 2038-2060), together with the retrieval and transport of waste (e.g., radiation sources, long-lived waste) the final disposing of which will not take place on the territory of RHFT. The disposal facility is scheduled to close in 2067, directly preceded by the construction of the final vault cover.

National Radioactive Waste Repository in Bátaapáti

An extension of the Püspökszilágy facility by such a rate which would satisfy the full demand of the nuclear power plant has not been possible, therefore, the National Project was started in 1993 with the objective of the final disposal of low and intermediate-level radioactive waste originating from the nuclear power plant. The preparation for the selection of site started, in the course of which the social acceptance was also an important aspect in addition to the technical suitability. The final document of geological, technical safety and economic studies proposed additional explorations in the region of Bátaapáti in 1996 for an underground repository in granite formation.

The overground geological surveys were continued in several stages until 2003. A final report was drawn up about the geological explorations at the end of 2003, with the main finding: 'the Bátaapáti site satisfies all the requirements stipulated in the Decree, therefore, geologically it is suitable for the final disposal of low and intermediate-level radioactive waste'. The geological authority with jurisdiction, the South Transdanubian Regional Office of the Hungarian Geological Survey wrote an opinion about this document and accepted the same by a resolution. The plan for underground exploration made for the period of 2004-2007 was aiming at the designation of the rock formation to accommodate the repository. The underground exploration works started in February 2005 with the excavation of inclined shafts.

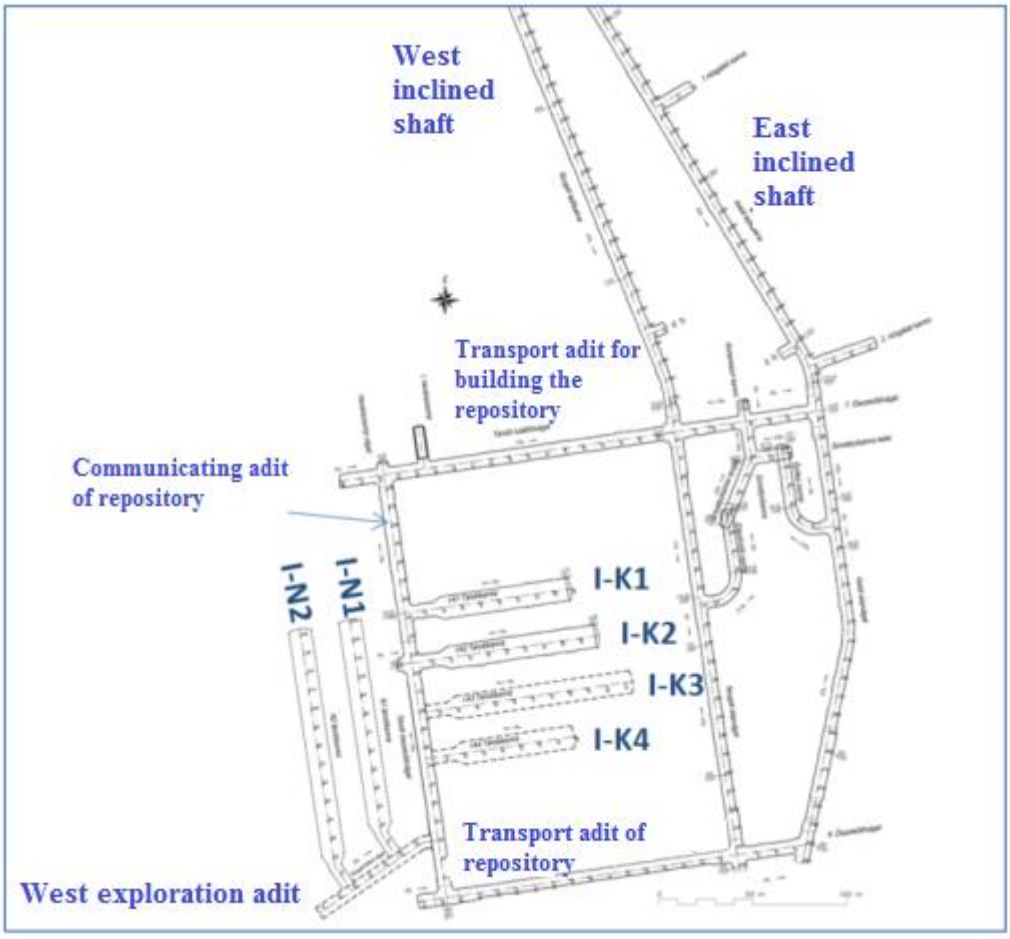
The construction of NRHT located in the public administration territory of Bátaapáti has been (is) performed in several stages and the commissioning into service and the licensing for operation of the specific parts of the facility completed are adjusted to this construction carried out in stages. The overground facilities of NRHT, the central and the technological building were completed in the first stage by mid-2008. Thereby, based upon the licence for commissioning issued on 25 September 2008 it became possible to take over one part of the solid waste accumulated in the Paks Nuclear Power Plant and its technological storage with a view to preparation for final disposal. In the second stage of establishment, the first two storage chambers were completed by 2012, and the technological systems serving these were also built. Access to the section of space designed as a final repository (

Figure 2-5) – located 250 m below the surface – can be gained through two inclined adits of 10% gradient of 1,700 m length each. Of the so-called inclined shafts, the western shaft is part

of the controlled zone and is in the service of radioactive waste transport, while the eastern shaft is in the service of the continuing building of the repository.

After the successful completion of the necessary procedure for licensing the operation, the final disposal of radioactive waste could be started in the storage chamber I–K1. The further expansion of the facility is planned adjusted to the delivery schedule of waste from the nuclear power plant, at this time, the excavation of storage chambers I–K3 and I–K4 is going on. Thereafter, the reinforced concrete vault, being part of the disposal system, must be built in chamber I–K2 in order to allow its taking into operation in 2017 adjusted to the delivery schedule of the Paks Nuclear Power Plant.

Figure 2-5 **Adit system of chamber field I of NRHT**



Source: National Programme

Simultaneously with the taking into operation of the first storage chamber, the preparations started for the continuing building of NRHT: this means the elaboration and licensing of such a new storage concept and disposal system, which allows the excavation of as large storage space as possible, as well as the as efficient utilisation of space as possible in the storage chambers in the available section of space. The basis of the new disposal concept is the thin-wall steel container, in which four drums – containing solid radioactive waste – are placed on the territory of the nuclear power plant, and the empty space is filled with radioactive cement slurry produced from the liquid waste of the nuclear power plant. The unit assembled in this way is referred to as a compact waste package. In the earlier disposal concept, the reinforced concrete container constituted an integral part of the engineered barrier system, its functions are taken over by the reinforced concrete vault built in the storage chambers. The compact waste packages

will be loaded in this vault. The efficiency of disposal is further enhanced by envisaging the disposal of drums holding low-level radioactive solid waste in the reinforced concrete vault I–K2 and on top of the sealed reinforced concrete vaults.

The National Programme includes the following for the planned operation and closing of the NRHT:

- The scheduled taking into service of additional chambers (I–K2, I–K3 and I–K4) in the eastern side of chamber field I is set for 2017, 2020 and 2026, respectively.
- Thereafter, the first chamber (I-N1) to be built in the western wing of the chamber field I is scheduled for commissioning into service by 2035.
- According to the plans, no waste will be delivered to the repository in the period of 2042-2061, during this time only the operations of maintaining the conditions, the operation of the monitoring system will be carried on.
- Thereafter – in 2062-2069 – the second western chamber (I–N2) will be taken into service, the repository will be enlarged and the decommissioning waste will be delivered and put into final storage.
- Before the construction of the two new units was considered, the plans estimated that the final closing of the repository would take place in 2081-2084, to be followed by institutional monitoring over 50 years.

The low and intermediate-level radioactive waste produced in the course of operation and decommissioning of the two new nuclear power plant units to be built on the Paks site has a significant impact on the design of NRHT with respect to both volume and scheduling. According to the National Programme, sufficient storage capacity can be established for the disposal of low and intermediate-level radioactive waste from the operation of the new nuclear power plant units in the remaining storage chambers available in chamber field I of NRHT.

According to the plans, the new nuclear power plant units will be in service until the middle of 2080s and then the production and delivery of decommissioning waste can be expected even up to 2100. All this means that in the course of operation of NRHT, preparations must be made for its operation for an additional period of 20-40 years.

2.1.6.3. Disposal of high level and long-lived radioactive waste

According to the National Programme, the disposal of high level radioactive waste must be solved in Hungary in a repository to be built in a stable, underground deep geological formation, regardless of the decision to be made later regarding the back-end of the nuclear fuel cycle. In the course of selection of the repository site and building of the storage facilities, the primary requirements include that the site, the accommodating rock and the technical solutions applied – adjusted to the characteristics of the waste placed – jointly ensure the isolation of waste from the living environment for the period of time required.

According to the current position, the deep geological repository is suitable for the direct disposal of the spent fuel (which in this case is considered as high level radioactive waste) and also for the reception of secondary high level radioactive waste originating from the reprocessing of spent fuel. The establishment of an underground geological repository provides a final solution in both cases, regardless of the decision to be made regarding the back-end of the fuel cycle.

Should all the spent fuel be produced until the final shutdown of the currently operating four units in Paks be processed, then about 500 tonnes of vitrified high level radioactive waste would

be produced. Its disposal would be possible in a deep underground geological repository of the same type but of significantly smaller size than the one required for the spent fuel.

2.1.7. Interim storage and final disposal of spent fuel

According to the National Programme, it is not yet necessary today to make a final decision regarding the back-end of nuclear fuel cycle of nuclear power reactors, however, it is necessary to note that regardless of the method of terminating the fuel cycle, the country must find a solution for the management of high level radioactive waste. In accordance with the research at this time, the deep geological underground repository is the most suitable solution. Currently, the policy regarding the back-end of the nuclear fuel cycle considers the open fuel cycle – i.e., the direct disposal of spent fuel from the nuclear power plant in this country – as a reference scenario. Accordingly, it is necessary to monitor the national and international changes (assessment), and they must be integrated in the cycle closing policy as required, however, simultaneously progress must be made in the subject of selecting the deep underground geological repository site (progress).

Four power generating reactor units with 500 MW nominal electric capacity each are in operation in Hungary on the site of the Paks Nuclear Power Plant, providing about 36% of the national electricity consumption over the long-term. The Parliament passed in 2014 the Act II of 2014 on the promulgation of 'Agreement on the cooperation between the Government of Hungary and the Government of the Russian Federation in the field of peaceful use of nuclear energy. Therefore, nuclear energy will have an important role over the long-term also in the future in Hungary's electric power supply through the building of two new nuclear power plant units of 1,200 MW nominal electric capacity each on the Paks site in accordance with the provisions of the Agreement.

2.1.7.1. Interim storage of spent fuel

The interim storage of spent fuel produced at the existing units of the Paks Nuclear Power Plant is implemented in the Interim Spent Fuel Storage Facility located at the Paks site. The Interim Spent Fuel Storage Facility (KKÁT) is a modular, vault type dry storage facility commissioned in 1997 and its filling with the spent fuel has also started. Thereafter, the continuous operation of KKÁT has been conducted simultaneously with its expansion and this activity is going on also today.

The interim storage of the spent fuel of the new nuclear power plant units can be implemented under the National Programme in the new Hungarian storage facility licensed for receiving the spent fuel or abroad. The environmental impact assessment of the new units according to the respective regulation contains the interim storage facility for the spent fuel of the new units as a reference scenario. However constructing an interim storage facility requires a separate environmental impact assessment procedure. The costs of building and operation of the storage facility must be taken into account in case of the storage to be implemented in Hungary and the period of interim storage must also be defined.

In case of interim storage abroad, the relevant conditions must be agreed upon in the negotiations between the parties. Interim storage in the Russian Federation is also possible under the Hungarian-Russian intergovernmental agreement promulgated by Act II of 2014.

The continuing expansion of KKÁT is planned by modules in accordance with the practice described earlier, adjusted to the rate of delivery of the spent fuel produced. The concept planning for the increase of capacity of KKÁT has started, however, the National Programme considers still the technical solution offering 527 storage positions per chamber, in harmony

with the currently effective licences. If a service time of 50 years of the currently operating 4 units of the Paks Nuclear Power Plant is taken into account, a layout of 36 chambers will be sufficient. In case of increasing the storage capacity from the 25th chamber, this may be reduced to 33 chambers. Should a decision be made to introduce reprocessing before the full construction of KKÁT, the modular layout will allow avoiding the need to build the last chambers.

The planned commissioning of the new nuclear power plant units into service is expected in 2025-2026 and consequently – taking into account a decay period of 5-10 years – the interim storage of the spent fuel should be expected from 2031 to 2036. The interim storage of the spent fuel must also be provided in case of the fuel of the new units. Its possibility in Hungary is also provided but storage abroad is also possible. Decision regarding the options must be made so that storage must be available by the time of removing the first charge from the spent fuel pool, whichever option is taken.

2.1.7.2. Final disposal of spent fuel

The National Programme intends to apply the "do and see" principle' regarding the final disposal of the spent fuel, i.e., the final stage of the nuclear fuel cycle. (The decision-making points are shown in ***Figure 2-7*** below.)

This means that the direct disposal of the spent fuel in Hungary was defined as a reference scenario, however, it is possible to change this when becoming aware of the new possibilities arising (assessment), through the observation of changes both in Hungary and abroad. If the open fuel cycle is selected, then the spent fuel disposed without processing must be classified as high level radioactive waste, which have considerable heat generation compared to the low and intermediate-level radioactive waste. In the course of the partial reprocessing already going on at a commercial scale, the uranium and plutonium isotopes suitable for further energy generation are segregated and as the by-product of processing high level long-lived radioactive waste remains, which must be placed finally in a deep underground geological repository, similarly to the spent fuel. According to the National Programme, the processing of spent fuel is a well-established practice applied at a commercial level today, however, it is a complex technology and therefore only a few countries have access to it. Therefore, a reprocessing plant should only be established in international cooperation, or in such a country, which has significant nuclear industry, therefore, if the reprocessing of spent fuel should be required in Hungary, then its implementation should be arranged abroad.

One of the highlights of the National Programme concerns the theoretical possibilities for the back-end of the nuclear fuel cycle. The Hungarian strategy regarding the management of spent fuel produced in the 4 units of the Paks Nuclear Power Plant currently in service may consider the fundamental possibilities as follows:

(a) Interim storage of the spent fuel followed by final disposal (direct disposal).

(b) Processing of the spent fuel abroad and final disposal of the radioactive waste produced in a deep underground geological repository to be established in Hungary (reprocessing).

(c) Processing of the spent fuel and the recovery of secondary actinides abroad and final disposal of the resulting radioactive waste in a deep geological repository to be established in Hungary (enhanced reprocessing).

Is the current design base of the relevant programme section of the National Programme for the disposal of high level and long-lived waste management. The cost estimate and financing system presented therein employs this as the so-called reference scenario. Should this be selected, the spent fuel will be disposed of directly in the deep underground geological

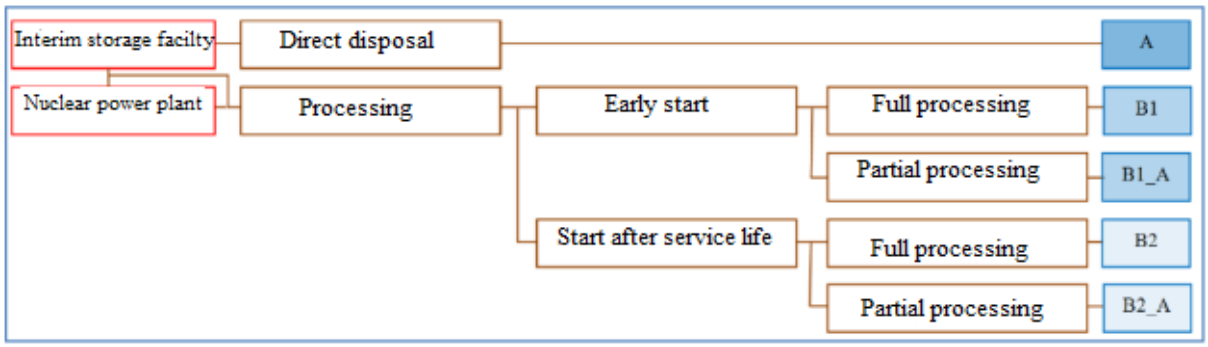
repository scheduled to operate from 2064 after storage over an extended period in the interim storage facility.

If the reprocessing of spent fuel was elected, then the spent fuel can be processed after a decay period of a few years within the nuclear power plant (i.e., even without interim storage). At this time, stored in the operating interim storage facility have decayed sufficiently and is suitable for chemical processing without any additional intervention. From the segregated uranium and plutonium ERU and MOX (and REMIX expected in the future) can be produced as fuel. At the same time, the 4 reactors current in service in the Paks Nuclear Power Plant cannot be operated with the MOX fuel. However, the recycling of uranium and plutonium can be proposed for the new nuclear power plant units.

The section (c) above – enhanced reprocessing – is different from the previous one only to the extent that a more advanced technology is applied in the course of reprocessing and so the technology permits the recovery of other, the so-called secondary actinides in addition to uranium and plutonium, from the spent fuel, either segregated from uranium and plutonium or together with plutonium. The other major difference is, although the high level radioactive waste remaining will be subject to vitrification just like in the earlier case, however, that the activity and radiotoxicity of this waste are much lower.

Therefore, the two fundamental, currently programmable modes of final management of spent fuel are direct disposal and processing. The strategic version described with scenario (c) is uncertain to such an extent that currently it cannot be recorded for the National Programme for the time being. ***Figure 2-6*** shows a summary of the system of relations for the scenarios considered in the National Programme.

Figure 2-6 **Scenarios for closing the nuclear fuel cycle of the operating units**

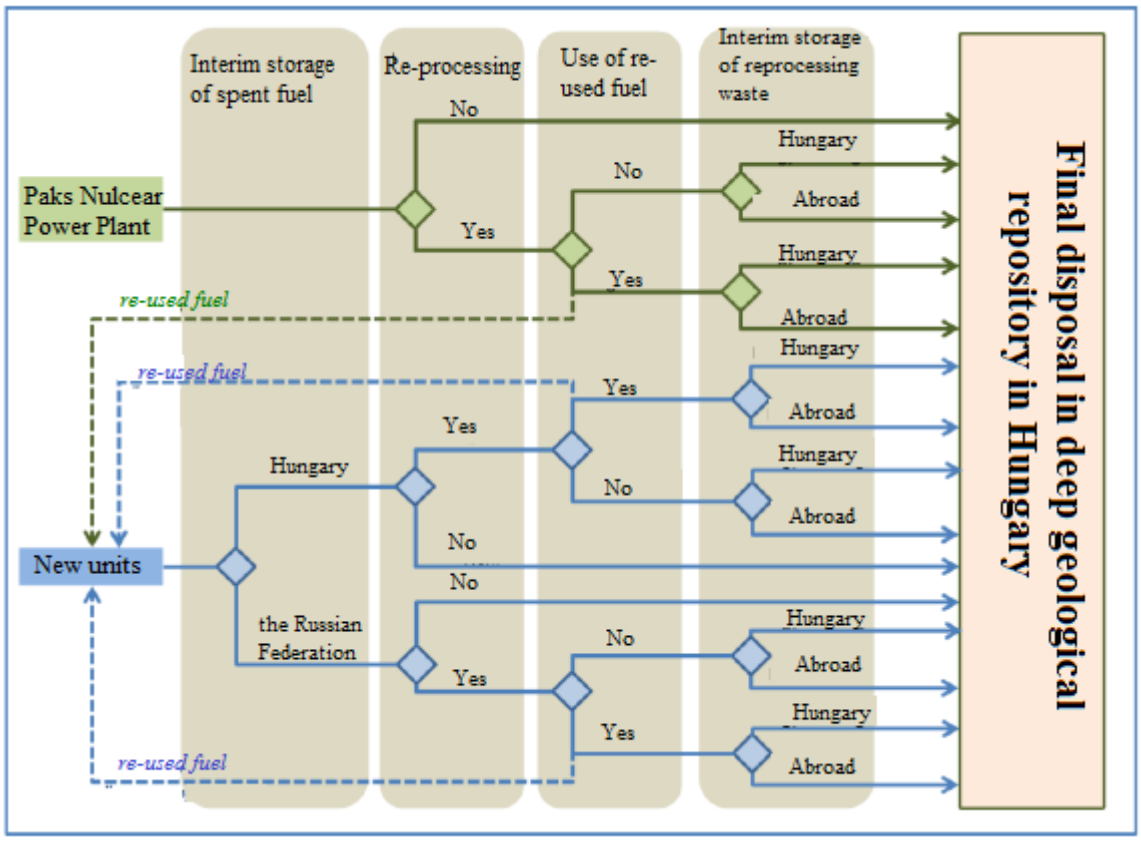


With respect to the new nuclear power plant units, the same strategies can be considered for the back-end of the nuclear fuel cycle as the ones considered for the operating reactors. According to industry forecasts, the use of reprocessed fuel may have an important role in the sustainable operation of the nuclear power plants. Therefore, the use of reprocessed fuel originating from the processing of fuel from the current 4 units of the Paks Nuclear Power Plant may also be proposed for the new units.

The National Programme defines a series of decision-making points regarding the closing of the fuel cycle. (See ***Figure 2-7.***) The first decision-making point arises in connection with the method of interim storage for the spent fuel of the new units. Thereafter, at the latest until the beginning of 2040s, the feasibility of the processing options must be assessed by means of a detailed, comparative safety, technical and economic analysis regarding the fuel cycle of the 6 units. The third decision-making point arises in the mid-2040s. The key point there is to define whether it would be preferable to change to the reprocessing to the spent fuel and the use of reprocessed fuel at the same time or the use of conventional uranium-dioxide fuel should be

continued. If a decision is made any time in the future regarding the reprocessing of spent fuel, then a 4th decision-making point also arises, regarding the interim storage of vitrified high level waste. All these decisions influence the final disposal of the spent fuel, at the same time they will not substantially change the necessity of establishing the deep geological repository.

Figure 2-7 **Decision-making points regarding the closing of nuclear fuel cycle**



Source: National Programme

2.1.8. Decommissioning of nuclear facilities

Radioactive waste is also produced related to the decommissioning of nuclear facilities, the final disposal of which must be provided.

In accordance with the extension of the service time to 50 years, the decommissioning of the units currently in service in the Paks Nuclear Power Plant will take place in the mid-2030s, and the latest decommissioning plan considered two options of implementation. One option is immediate, the other – currently preferred – option considers the protected conservation of the primary circuit over 20 years. The operation of the new nuclear power plant units is scheduled to start in the middle of the 2020s and considering the projected service life of 60 years, it will be terminated by the middle of the 2080s. In case of the new units, the plans prefer the concept of immediate decommissioning. According to the National Programme, it is preferable to coordinate the decommissioning strategy of the 6 units on a single site later on, which may lead to a slight extension of the protected conservation period with respect to the currently operating 4 units.

In connection with the decommissioning of the first 4 units of the Paks Nuclear Power Plant, it is expected that a total of 27,000 m^3 low and intermediate-level waste (of which about 80% can be very low-level waste) and 73 m^3 high level waste would be produced. Pursuant to the data supply available at this time, 16 250 m^3 very low-level, 2050 m^3 low and intermediate-level and

85 m^3 high-level radioactive waste is expected to result from the decommissioning of one unit of the pressure water nuclear power plant type VVER-1200 of Russian design.

From the decommissioning of the Budapest Research Reactor in 2033, the production of 260 m^3 low and intermediate-level waste is expected. With respect to the Training Reactor, this value is as low as 50 m^3, considering a decommissioning in 2027. Related to the decommissioning production of high level waste is not expected in case of any of the reactors.

A separate problem is presented by the radioactive waste facilities themselves, the decommissioning waste of which is to be disposed in the repositories themselves before their final closing.

2.2. Analysis of correlations with other relevant plans and programmes

The harmony of the National Programme with the objectives defined in the EU and Hungarian plans and programmes is analysed in greater detail in Chapter 3. Here the harmony with the National Policy serving as a direct preliminary to the planning with the National Programme is analysed.

The Programme represents a single stage of a very long-term planning process in itself, and one of its main objectives is to secure the external and internal consistence and structuring of the process over time. Accordingly, the National Programme has been elaborated on the basis of the National Policy and by considering the requirements of international and national legal regulations applicable. Thereby, the two documents are in full harmony with each other.

2.3. Presentation of versions

Most of the measures included in the National Programme implement the safe management and final disposal of the (low and intermediate-level) radioactive waste by making use of the existing facilities (NRHT, RHFT, KKÁT) or their eventual further expansion. In these cases, no versions can be considered.

The version included among the solutions of the National Programme presents itself in case of the interim storage of the spent fuel of the new nuclear power plant units. According to the National Programme, this can be implemented in a new Hungarian repository licensed for the acceptance of spent fuel or abroad. The conditions of interim storage in Hungary are available also at present and over the long-term (the place of the interim storage facility is shown on the layout plan of the site of the new units). The costs of building and operation of the storage facility must be taken into account in case of the storage to be implemented in Hungary and the period of interim storage must also be defined.

In case of interim storage abroad, the relevant conditions must be agreed upon in the negotiations between the parties. Interim storage in the Russian Federation is also possible under the Hungarian-Russian intergovernmental agreement promulgated by Act II of 2014.

In case of the power generation reactors, several scenarios (which can be regarded as versions) can be proposed for the back-end of the nuclear fuel cycle, the implementation of which is feasible under step-by-step decision making, therefore, the concrete items of the solutions at this time cannot be included in the National Programme and the SEA. Therefore, the Program does not yet include a concrete solution.

3. HARMONY OF THE NATIONAL PROGRAMME AND THE OBJECTIVES SET AT THE COMMUNITY AND NATIONAL LEVELS

In this chapter, the evaluation is carried out according to Section 3 of Annex 4 defining the substantive requirements of the relevant Government Decree No. 2/2005, i.e., the objectives of the National Programme are compared with the international, EU and national objectives of environmental protection and nature conservation relevant for the programme. The evaluation is carried out separately for the radiological and conventional environmental areas.

3.1. The key elements of legal regulation

3.1.1. Foundations of legal regulation

The Act CXVI of 1996 on Atomic Energy established the modern legal foundations for the management and disposal of radioactive waste. The Act on Atomic Energy defines the fundamental principles of the use of nuclear energy, including also the fundamental principles regarding the spent nuclear fuel assemblies. **The law stipulates that safety has the supreme priority over any and all other aspects in the use of nuclear energy.**

The user of nuclear energy must procure that in the course of its activities, the reasonably achievable lowest volume of radioactive waste is produced. In the course of application of nuclear energy, the safe disposal of the radioactive waste and spent fuel produced must be procured in harmony with the latest evidence-based results of science, the international requirements and experience, so that no greater than acceptable burden is passed onto future generations.

The Act on Atomic Energy also stipulates that the ultimate responsibility related to the management of spent fuel and radioactive waste produced in Hungary shall rest with the Hungarian State. The Hungarian State shall bear the ultimate responsibility for the safe final disposal of these materials, also including the waste produced as by-product, if they are delivered for processing or re-processing from Hungary to any of the Member States of the European Union or to third countries.

The radioactive waste produced in Hungary must be finally disposed of in Hungary, except if there is such an agreement in effect with a country[9] undertaking final disposal at the time of delivery, under which the radioactive waste produced in Hungary can be transported to the radioactive waste repository of the country concerned for the purposes of final disposal. Before transport to the country undertaking final disposal, Hungary must ascertain to the fullest possible extent that the target country:

(a) entered into a relevant agreement for the management of spent fuel and radioactive waste with the European Atomic Energy Community or is signatory to the joint agreement on the safety of spent fuel and the management of radioactive waste,

(b) has such programmes in place for the management and final disposal of radioactive waste, the high level safety objectives of which are equivalent to the aims defined in the Atomic Energy Act, and

[9] In harmony with the provisions of Article 16(2) of Council Directive 2006/117/Euratom of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel, considering the criteria defined by the European Commission

(c) the operation of its radioactive waste repository has been licensed for the radioactive waste to be transported, had been in operation before the transport and is under management in accordance with the requirements defined in the programme for the management and final disposal of radioactive waste.

3.1.2. The most important items of international and national legal regulations

The legal regulations considered most important for the management of spent fuel and radioactive waste as well as the relevant environmental protection procedures are listed below:

International standards

- IAEA International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources (IBSS #115.)
- IAEA Safety Standards, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards General Safety Requirements Part 3 No. GSR Part 3
- IAEA Safety Standards, Predisposal Management of Radioactive Waste, General Safety Requirements Part 5, No. GSR Part 5
- IAEA Safety Standards, Decommissioning of Facilities, General Safety Requirements Part 6, No. GSR Part 6

Legal regulations of the European Union

- Council Directive 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionizing radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom
- Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste

Items of Hungarian legal regulation

Acts

- Act LIII of 1995 on the general regulations for the protection of the environment
- Act CXVI of 1996 on atomic energy
- Act I of 1997 on promulgating the Agreement entered into on 20 September 1994 in Vienna in the framework of the International Atomic Energy Agency on nuclear safety
- Act LXXVI of 2001 on promulgating the joint agreement entered into on the safety of management of spent fuel and radioactive waste in the framework of the International Atomic Energy Agency
- Act II of 2014 on the promulgation of Agreement on the cooperation between the Government of Hungary and the Government of the Russian Federation in the field of peaceful use of nuclear energy

Government Decrees

- Government Decree No. 2/2005 of 11 January 2005 on the environmental assessment of specific plans and programmes
- Government Decree No. 314/2005 of 25 December 2005 on the procedure of environmental impact assessment and integrated IPPC licensing

- Government Decree No. 118/2011 of 11 July 2011 on the nuclear safety requirements of nuclear facilities and the related activities of authorities
- Government Decree No. 246/2011 of 24 November 2011 on the safety zone of nuclear facilities and radioactive waste disposal facilities

  Government Decree No. 124/1997 of 18 July 1997 on the scope of radioactive materials and equipment producing ionizing radiation not covered by the Act CXVI of 1996 (It was repealed as of 1 January 2016)
- Government Decree No. 155/2014 of 30 June 2014 on the safety requirements of storage facilities for the interim storage or final disposal of radioactive waste and the relevant activities of authorities
- Government Decree No. 190/2011 of 19 September 2011 on physical security and the relevant licensing, reporting and monitoring systems regarding the application of atomic energy

  Government Decree No. 275/2002 of 21 December 2002 on the monitoring of the national radiation situation and radioactive material concentrations (As of 1 January 2016 it has been replaced with Government Decree 489/2015 of 30 December 2015, see below)

Ministerial decrees

- Decree No. 23/1997 of 18 July 1997 of the Minister for Welfare on determining the exemption activity concentration and exemption activity level of radionuclides (As of 1 January 2016 it has been replaced with Government Decree 487/2015, see below)
- Decree No. 47/2003 of 8 August 2003 of the Minister for Health, Social and Family Affairs on specific issues of interim storage and final disposal of radioactive waste and on the radiological hygiene issues of radioactive materials enriched in the course of industrial activities and occurring in nature
- Decree No. 16/2000 of 8 June 2000 of the Minister for Health on the implementation of specific provisions of the Act CXVI of 1996 on atomic energy
- Decree No. 15/2001 of 6 June 2001 of the Minister for Environmental Protection on the radioactive emissions into the air and water in the course of application of atomic energy and their monitoring

Several changes to the legislation were made during the drawing of the SEA. As of 1 January 2016, new legal regulation related to the radiation protection requirements and the related licensing, reporting and control system was adopted, the main elements of which are as follows:

- Requirements related to protection against ionizing radiation are specified by Government Decree 487/2015 of 30 December 2015 on protection against ionizing radiation and the related licensing, reporting and control system.
- Decree 23/1997 of 18 July 1997 of the Minister for Welfare on the determination of the exemption activity concentration and the exemption activity level of radionuclides was repealed
- Government Decree 275/2002 of 20 December 2002 on the monitoring of the radiation situation and substance concentration radioactivity in Hungary was replaced with Government Decree 489/2015 of 30 December 2015 on the control rules of environmental

radiation situation defining radiation exposures of natural and artificial origin affecting the population and on the volumes to be measured.

3.2. Documents regarding the specific radiological environmental area

3.2.1. The most important community objectives

(A) The EURATOM 2011/70 Directive

Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste stipulates for the Member States the elaboration and approval of a national policy and a National Programme for the management of spent fuel and radioactive waste. The relevant requirements and fundamental principles were presented in Chapter 2 of the SEA.

The National Programme under review was elaborated for the implementation of requirements of this community document in compliance with the fundamental principles and substantive requirements of the Directive.

(B) The EURATOM 2013/59 Directive

Council Directive 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionizing radiation defines the unified fundamental safety requirements for the protection of health of the persons exposed to occupational, medical and residential radiation exposure against the dangers of ionizing radiation.

In the National Programme under review, the solutions defined for the management of spent fuel and radioactive waste must meet the safety requirements defined in the said directive of the Council. Compliance in each case must be analysed in the establishment and operation licensing procedures of the individual facilities.

3.2.2. The most important related Hungarian objectives

National Nuclear Research Programme[10]

The availability of adequate professional knowledge and nuclear safety culture is a precondition for the safe application and social acceptance of nuclear energy over the long-term. Recognising this need, the participants of the nuclear energy sector significant at the national level have elaborated forward-looking, strategically significant, professionally well-defined and cohesive research and development tasks and objectives to be attained.

The tasks of the supported project are primarily defined by the safe operation of the existing Park Nuclear Power Plant units, providing the technical-scientific background and the preparation for the building of new units. Conducting research into reactor safety and the expansion of experiment-based knowledge promote the preservation, reproduction and growth of nuclear competence in this country. The aims of the research and development project include the answers given to the safety questions related to the operating nuclear power plant units on the basis of specialized knowledge, the performance of research and development tasks to provide grounds for the licensing, construction and commissioning into service of the new nuclear power plant units as well as ensuring the Hungarian participation in the international efforts aiming at the implementation of long-term objectives of nuclear power engineering,

[10] Source: http://mta.hu/mta_hirei/elindult-a-nemzeti-nuklearis-kutatasi-program-mta-ek-nkfi-alap-136735/

primarily the closing of the fuel cycle and the research conducted into the new type, 4th generation reactors. (This latter task is also directly connected to the objectives of the National Programme.)

Owing to the project, a comprehensive national nuclear knowledge base can be established to answer the questions connected to the existing and the newly built units, the computerized simulation of the reactor processes related to the various generations as well as creating the national strategic background for closing the fuel cycle. The medium-term development plans of the national nuclear research infrastructure are elaborated in the framework of the project and it also contributes to the development of training and education of nuclear engineering specialists.

3.3. Documents related to the conventional specific environmental area

3.3.1. The most important related community objectives

(A) Objectives of the EU 2020 strategy[11]

The Europe 2020 considers three priorities reinforcing each other mutually:

- Smart growth: establishment of economy based on knowledge and innovation,
- Sustainable growth: a more resource efficient economy, with better harmony and adjustment to the environment, and greater competitiveness,
- Inclusive growth: stimulation of high level of employment, the establishment of an economy characterized by social and regional cohesion.

The objectives of the programme reviewed can be connected to the establishment of **an economy in harmony with the environment**.

Moreover, EU 2020 defines 10 thematic objectives as well. From among these, the National Programme can be primarily connected to the environmental themes of the 6th thematic objective ('Environmental protection and promotion of the efficiency of resource use'), however, with respect to the final disposal of the spent fuel, the aims of the 1st thematic objective (Research, technological development and reinforcement of innovation) may also have a role. (In the "do and see" principle the basis of judgement can be provided exactly by the research and technological development plans and programmes.)

(B) Decision No 1386/2013/EU: 'Living well, within the limits of our planet' - 7th Environment Action Programme[12]

With respect to the SEA, one of the comprehensive and decisive environmental protection document is the environment action programme published by the EU in 2013. This programme summarises the expectations, which have already been published earlier in several different documents, covering specific sub-areas. The fundamental objective is to achieve that the **Union sets the economy on a smart, sustainable and inclusive growth trajectory by 2020** through various political instruments and measures, with the aim to establish an economy based on low carbon-dioxide emission and resource efficiency

[11] Source: Europe 2020 – A strategy of smart, sustainable and inclusive growth (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:HU:PDF)

[12] Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 'Living well, within the limits of our planet' Text with EEA relevance (Source: http://moszlap.hu/uploads/files/kornyvedcselprogrhat.pdf)

In the field of environmental protection, the Union undertakes several commitments, *inter alia*, including the abatement of greenhouse gas emission, enhancement of energy efficiency, the increase of application of renewable energy sources, prevention of the reduction of biological diversity and the deterioration of ecosystem services, ensuring the good ecological condition of the European waters.

With respect to the National Programme, the waste management objectives must be highlighted, i.e., the requirement to prevent and mitigate the harmful impacts arising from the generation and management of waste. In order to protect the environment and human health, to mitigate the global impacts of resource use, it is required to apply the waste hierarchy: the sequence of prevention, preparation for recycling, recycling and other re-use and disposal. However, in each development plan and programme, the general system of objectives defined in the environment action programme must be taken into consideration.

Thereby, the National Programme may also contribute to the high-priority objectives of the 7th environment action programme of the European Union, primarily to the protection, conservation and development of the union natural capital; the establishment of a resource efficient, eco-friendly and competitive union economy; and the protection of the union citizens from the burdens related to the environment and the risks threatening their well-being.

(C) Review of the EU Sustainable Development Strategy (EU SDS) - Renewed Strategy [13] (

The renewed sustainable development strategy of the EU (hereinafter: EU SDS) has a comprehensive objective to identify and elaborate such measures, which allow for the EU the continuous improvement of quality of life both for the present and future generations, through establishing such sustainable communities which efficiently manage the resources and efficiently use them and may exploit the ecological and social innovation possibilities offered by the economy, ensuring thereby progress, environmental protection and social cohesion.

The fundamental objectives of EU SDS:

- **Environmental protection:** Safeguard the Earth's capacity to support life in all its diversity, respect the limits of the planet's natural resources and ensure a high level of protection and improvement of the quality of the environment. Prevent and reduce environmental pollution and promote sustainable production and consumption to break the link between economic growth and environmental degradation. Prevent and reduce environmental pollution and promote sustainable production and consumption to break the link between economic growth and environmental degradation.
- Social justice and cohesion: Promote a democratic, socially inclusive, cohesive, healthy, safe and just society with respect for fundamental rights and cultural diversity that creates equal opportunities and combats discrimination in all its forms.
- Economic prosperity: Promote a prosperous, innovative, knowledge-rich, competitive and eco-efficient economy which provides high living standards, and full and high-quality employment throughout the European Union.
- Meeting our international responsibilities: Encourage the establishment and defend the stability of democratic institutions across the world, based on peace, security and freedom. Actively promote sustainable development worldwide and ensure that the European Union's internal and external policies are consistent with global sustainable development and its international commitments

Review of the EU Sustainable Development Strategy (EU SDS) - Renewed Strategy (Source: http://register.consilium.europa.eu/doc/srv?l=HU&f HU&f= ST%2010117%202006%20INIT)

From among the main challenges defined in the document, the National Programme is related to the objectives of sustainable development, consumption and public health. Of the sub-objectives defined, several are still timely even 10 years after the publication of the document. To be highlighted with respect to the National Policy:

- Prevention of the generation of waste and the improvement of efficiency of using the natural resources through the application of the life-cycle concept and promoting re-use and recycling.
- Enhancement of protection against dangers to health, through developing the coordinated capacity for responding to these dangers

3.3.2 The most important related Hungarian objectives

(A) Hungary's National Reform Programme of 2015

With respect to the development of economy, the state of the country is defined by the National Reform Programme. The programme presents the country's progress considering the recommendations of the Commission for 2014 and the national commitments related to the quantified objectives of EU 2020, which are as follows:

- Connected to the objective of improving the **employment** level we have targeted the increase of employment ratio of the population of 20-64 years of age to 75 % by 2020.
- Connected to the objective of **research and development** we have undertaken to increase the level of research and development expenditures to 1.8% of the gross domestic product by 2020.
- Connected to the **energy and climate** policy objectives of the Europe 2020 Strategy, the increase of ratio of renewable energy resources to 14.65%, total energy conservation by 10 % and the maximum 10% increase of the greenhouse gas (hereinafter: GHG) emission (compared to the level of 2005) were undertaken, adjusted to the local conditions, by 2020 in the sectors not falling under the scope of the EU emission trading system.[14]
- **Training:** Connected to the Europe 2020 objective for the improvement of educational standards, Hungary undertakes to increase the proportion of people with college or equivalent qualification to 30.3% (in the age group of 30-34 years) and decreasing the early school leavers to 10% (in the age group of 18-24 years) by 2020.
- **Social alignment:** Connected to the poverty objective of the Europe 2020 Strategy, Hungary undertakes to reduce the poverty rate of families with children, the number of people living in severe financial need and people living in low level of labour intensity households by 20% each by 2020; this is equivalent to the removal of 450,000 people from poverty - filtering the overlaps among the population strata covered by the three indicators.

Clearly, this document cannot be connected directly to the National Programme, however, R&D, as a contributor to "progress by judgement", the climate and energy policy, as activities having favourable impact on the abatement of GHG emissions through the use of nuclear energy may reveal a link.

[14] Hungary has significantly exceeded the community target of GHG emission reduction by 20-30% compared to the level of 1990, therefore, even a 10% increase should be allowed for the sectors not falling under the scope of the emission trade (e.g., transport, buildings).

(B) National concept on the transition towards sustainability – National Sustainable Development Framework Strategy 2012-2024[15]

As described in the introduction, the SEA intends to deal not only with environmental issues but also with determining whether the National Programme is well-founded with respect to sustainability. When considering this group of questions, this document is of fundamental importance, which was adopted in its May 16, 2012 session of the National Council for Sustainable Development.

The first National Sustainable Development Strategy adopted by the Government in 2007 focused on the elaboration of the sustainability priority objectives in a sectorial approach. The second Framework Strategy focuses on the **presentation of the state of our national resources. The identification of processes 'indebting' the future generations and the establishment of a system of institutions to assist in the appropriate maintenance of resources.**

In the approach of the Framework Strategy, the permanent provision of public good is the aim of transition towards sustainability. The conservation of our resources representing the fundaments of the possibility of good life means governance balancing the short-term interests, regulation and management. Instead of the earlier sectorial approach, the sustainability policy will focus on people and communities.

Direct or indirect links with the document analysed in the SEA are identified in the following items from the system of objectives of the Framework Strategy:

- **Health**: … abatement of environmental risk factors.
- **Social resources:** strengthening of values, moral standards and attitudes, which are positive with respect to the sustainable society.
- **Natural resources:** The environmental carrying capacity, as a limit to management, must be asserted.
- **Reduction of environmental exposure on man**

Therefore, several points of connection are manifest regarding the sustainability strategy. When selecting the solutions, it is important to integrate these criteria.

(C) National Environmental Protection Programme IV. (2014-2020)[16]

The 1st strategic objective of the National Environmental Programme (hereinafter referred to as the NEP), i.e. "The Improvement of the Environmental Terms of Life Quality and Human Health" discusses the topic "Nuclear Safety and Radiation Health" covered by the National Programme as a partial objective (See ***Figure 4-1***.) Within this, the following objectives are defined:

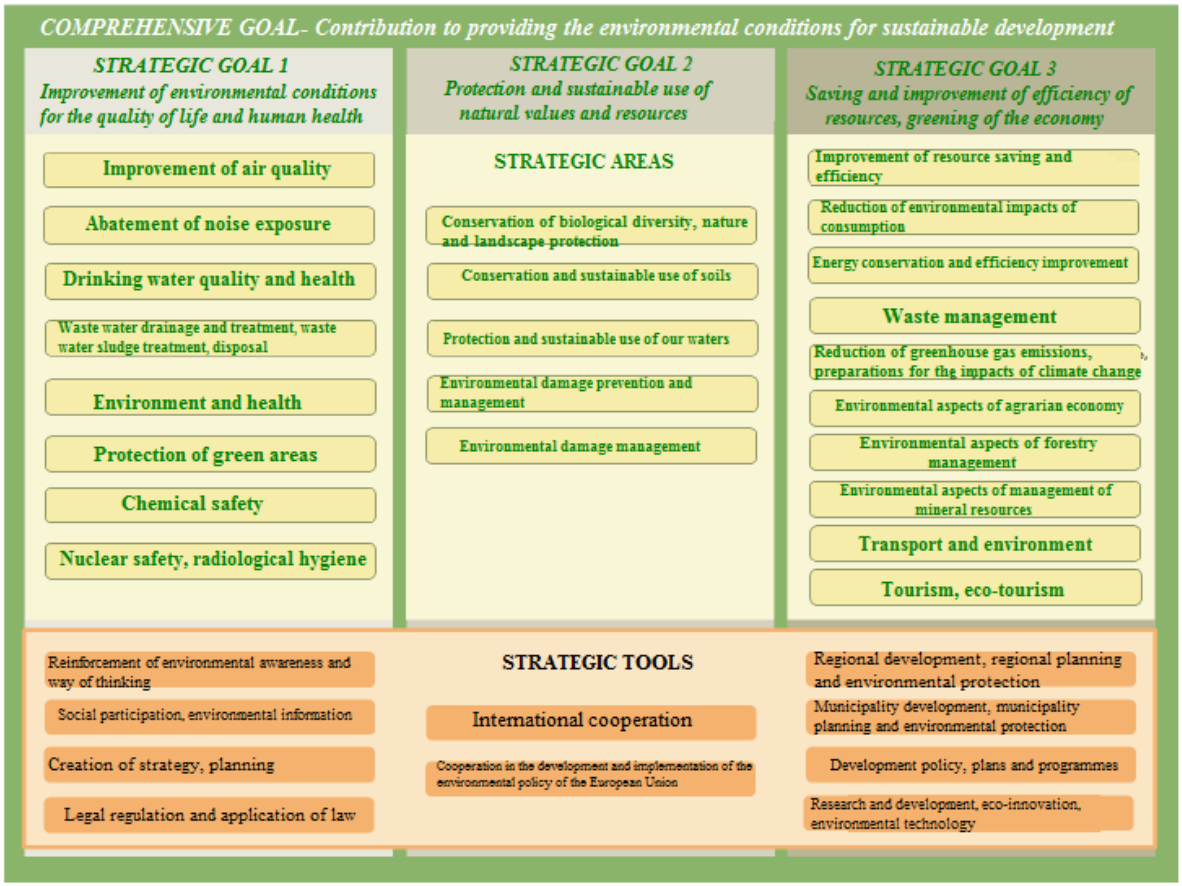
- Safe disposal of radioactive waste and spent fuel.
- Appropriate management of radioactive waste.
- Detection of ionizing and non-ionizing radiation exposure, reduction of radiation exposure of the population.

[15] National concept of the transition towards sustainability – National Sustainable Development Framework Strategy 2012-2024 (Source: http://www.nfft.hu/dynamic/NFFS_rovid_OGYhat_melleklete_2012.05.16_vegso.pdf)

[16] National Environmental Protection Programme No. IV (Source: http://20102014.kormany.hu)

– Early detection, warning, alerting of nuclear emergency, the analysis and evaluation of the actual and expected radiation situation.
– Preparations for and cooperation in the prevention of nuclear emergencies

Figure 4-2 **Presentation of strategic objectives in NEPP IV**



From among the measures required for achieving the objectives, the aims related to the National Programme are as follows:

– Performing the tasks related to the safe disposal and appropriate management of radioactive waste and spent fuel. (Operation of the National Radioactive Waste Repository of Bátaapáti and its expansion as required.) Performing investment works related to the safety enhancement of the RHFT in Püspökszilágy. Expansion and renovation of the KKÁT in Paks. Performing the establishment and site research works of a storage repository suitable for the disposal of high level radioactive waste. Activities related to the preparation of decommissioning of nuclear facilities.)
– In case of an emergency situation, the transmission of data of the monitoring system to the appropriate decision-preparation and decision-making agencies (National Atomic Energy Authority, National Disaster Management General Directorate).
– Development of the national environmental radiological monitoring system and of the measuring methods, modernisation of the instrumentation and laboratory infrastructure. Coordinated operation and development of mobile laboratories.
– Development of decision-support systems for nuclear accident management and maintenance of readiness service.

The objectives are basically harmonised for the management of spent fuel and radioactive waste in the National Programme and NEPP.

(D) National Waste Management Plan 2014-2020[17]

The effective National Waste Management Plan (hereinafter: NWMP) covers the period of 2014-2020, adopted by the Government by its Resolution No. 2055/2013 of 31 December 2013.

The plan defines that at present, the energy industry in Hungary belongs to the industries producing the largest volumes of waste, however, the nuclear energy industry is not included here. No significant amount of conventional waste is produced either in the industry or in the related waste management facilities. Therefore, the NWMP does not deal with either the radioactive waste or the spent fuel, with the exception of the management of hazardous materials produced in the health care institutions within the hospital, where the radioactive materials are also specified. The comprehensive objectives regarding all the waste streams in the action programme of NWMP must also be taken into consideration for the non-radioactive (conventional) waste produced in the facilities managing and disposing the former. These are the increase of re-use proportions; the establishment and development of selective collection; reduction of waste generation.

Moreover, the NWMP highlights also the importance of education, training, system of institutions, forming of attitude and information, from among which primarily the education and training can be important also with respect to the National Programme.

The National Programme can be considered as a waste management programme, which presents the management of a special waste, i.e., the radioactive waste. Its objectives are harmonised with the comprehensive objectives of the NWMP, the National Programme takes into consideration the waste management hierarchy. (See: reprocessing with respect to the spent fuel, segregated collection of waste of different types.) Conventional waste is also produced in the existing management and storage facilities as well as in the ones planned for the long-term. The NWMP requirements must be enforced with respect to these.

(E) National Development 2030 – National Development and Regional Development Concept (NDRDC)[18]

In its chapter regarding the current situation, the document under analysis defines that the nuclear energy has a dominant proportion in Hungary. In other respects, it does not deal with the nuclear power plant or its spent fuel and waste or just marginally. The valuable natural resources: the Paks Nuclear Power Plant is shown on the map of mining and energy industry. In the section dealing with Tolna County, the establishment of innovative environmental industry and energy industry possibilities mentioned among the development directions with the operating knowledge basis, from the measure for providing the vocational training and higher education related to the development of the Paks Nuclear Power Plant. This shows that the use of nuclear energy is expected also over the longer-term. This point is reinforced by the listing of the Paks Nuclear Power Plant among the power stations in the National Regional Master Plan[18] (Act XXVI of 2003) made based upon the Concept.

(F) National Energy Strategy 2030[19]

[17] National Waste Management Plan 2014-2020. (Source: nkfih.gov.hu/download.php?docID=28337)

[18] National Development 2030 - National Development and Regional Development Concept and National Master Plan (Source: http://www.terport.hu/webfm_send/4204))

[19] National Energy Strategy 2030 (Source: nkfih.gov.hu/szakpolitika-strategia/energetika/nemzeti-energiastrategia)

The alternatives on the electricity-producing sector listed in the Strategy consider significant use of nuclear energy and a lower but considerable use of renewable resources.

The National Energy Strategy includes the short SWOT analysis below regarding the use of nuclear energy:

Internal factors	**Strengths** High proportion, existing background; reduction of energy imports, attainment of decarbonisation goals, enhancement of supply security	**Weaknesses** Social acceptance; eventual sense of hazard; high investment demands and long installation process
Boundary conditions	**Opportunities** Emergence of fourth generation technology; fulfilment of emission objectives	**Threat** Management, transport and exports of spent fuel; higher risk in case of disaster

Source: National Energy Strategy

The National Energy Strategy anticipates the use of nuclear energy also over the long-term, as it proposes also the building of new units on a new site for the period after 2038.

The Strategy includes the following regarding the waste issue:

> 'The final disposal of low and intermediate-level waste from nuclear power plant – also including the waste originating from the decommissioning of nuclear power plant – will take place in our country in a facility meeting all the technical and safety criteria, the Bátaapáti National Radioactive Waste Repository. Considering any version of the nuclear fuel cycle, the interim storage of the spent nuclear fuel for a few decades must be considered as elements of the cycle, regardless of the version of closing the fuel cycle to be selected in the future. The interim storage of the spent fuel must be provided in Hungary through the extension and continuous operation of the KKÁT. The extension of KKÁT must be provided to such a rate which is adjusted to the extension of service life of the nuclear power plant, also including the extension of licences of the facility.'

The quotation shows that **the National Energy Strategy and the National Programme are fully harmonised.**

3.2. Environmental protection system of objectives compiled from the community and the national objectives and the National Programme

Having reviewed the relevant community and national objectives overlappings between them can be detected and there are also similar objectives in different wording. Therefore, a synthesis has been made from the objectives of the documents listed in Chapter 3.1. The following ***Table 3-1*** analysis the availability of connection points of the National Programme to these objectives and if there are such points, whether they help of prevent the attainment of the objectives. The first column of the table includes the objectives of the integrated system of objectives relevant for the National Programme, the second column identifies the document including the requirement, and the third column shows the way in which the Programme is connected to these objectives.

The markings as follows have been used in the table:

☺ favourable judgement (i.e., the National Programme promotes the attainment of the objective)

😐 there is no assessable correlations with the objectives

☹ unfavourable judgement (i.e., the National Programme hinders achievement of the objective)

☺/☹ it cannot be judged in the current phase

Table 3-1 **Environmental objectives and the National Programme**

Environmental protection goals	The document including the objective	Connection
1. It protects the environment and human health through the prevention or mitigation of the harmful impacts arising due to the generation and management of waste, as well as the reduction of global effects of the use of resources and the improvement of efficiency of this use.	EU 2020, EU - Environment Action Programme	☺
2. Application of the waste hierarchy: prevention, preparation for re-use, re-use, other recycling and disposal. Through the improvement of efficiency of using the natural resources through the application of the life-cycle concept and promoting re-use and recycling.	EU 2020, EU-Environmental Protection Action Programme, EU SDS, NWMP	☺
3. Protection of the EU citizens from the exposure related to the environment, the risks to their health and well-being, *inter alia*, through the development of coordinated response capacity to these dangers	EU 2020, EU-Environmental Protection Action Programme, EU SDS, NFFS, NEPP IV	☺
4. Limitation of emissions/exposure posing hazards to human health and the quality of life	EU-Environmental Protection Action Programme, NFFS, NEPP IV	☺
5. Reduction of chemical risk and increase of environmental safety	NDRDC, NEPP IV	☺
6. A commitment has been undertaken to increase the level of research and development expenditures to 1.8% of the gross domestic product by 2020.	EU 2020, EU SDS	☺/☹
7. Reduction of GHG emissions by 20% (or even by 30%) compared to the 1990 level. Hungary has overfulfilled this commitment, therefore, an increase of up to 10% is also allowable, in principle. in the sectors not subject to emissions trading (e.g. transport, buildings) by 2020.	EU 2020, EU-Environmental Protection Action Programme, EU SDS, NRP, NEPP IV	😐
8. Increase of the share of renewable energy resources to 20% (10% in the transport sector), including geothermal energy and waste recovery as well Hungarian target: 14.65 % until 2020	EU- Environmental Protection Action Programme, EU SDS, NRP, NEPP IV, National Energy Strategy	☺/☹
9. Preservation of biodiversity and integration of its consideration into decision-making in the individual sectors, strategies and programmes	EU-Environmental Protection Action Programme, NEPP IV	😐
10. Ensuring the good ecological condition of European waters	EU-Environmental Protection Action Programme, NEPP IV	😐
11. Appropriate management of radioactive waste	NEPP IV, National Energy Strategy	☺
12. Safe disposal of radioactive waste and spent fuel	NEPP IV, National Energy Strategy	☺
13. Damage mitigation: reduction of the rate of pollution, its elimination and monitoring	NEPP IV, NWMP	☺
14. Establishment of culture supporting sustainability, strengthening of values, moral standards and attitudes, which are positive with respect to the sustainable society.	NFFS	☺/☹

Environmental protection goals	The document including the objective	Connection
15. Promotion of an environmentally aware approach and enhancement of awareness about nature, environmental protection and energy	NEPP IV	☺/☹
16. Development of the national environmental radiological monitoring system and of the measuring methods, modernisation of the instrumentation and laboratory infrastructure	NEPP IV	😐

The table shows that the National Programme will help the achievement of goals of the relevant system of objectives in most of its elements. We have not seen an objective in the current stage, where the National Programme would be manifest as a preventive factor. However, we have identified several such objectives, where the current status cannot be evaluated. Its underlying reason is either the fact that the planning is not yet in a stage in which the impact on the objective could be assessed or there is no such a reference in the National Programme through which the achievement of the objective could be influenced. The judgement can be frequently subject to decisions taken later. For example, a decision in favour of reprocessing and use will certainly have a favourable effect regarding sections 6 and 15. At the same time, it is to be noted that these decisions will be made beyond the time horizon of the environmental objectives listed. Regarding the latter, we have included such proposals which may promote the Programme.

3.3. Internal consistence of the National Programme

The National Programme is an independent stage of a long-term planning system, however, including no decisions. The facilities included are the outcomes of an earlier decision-making process and the facilities planned for the subsequent period will be the outcomes of a later decision-making process. **Therefore, the programme primarily summarises this long-term process, defines principles and goals, therefore, its main task is exactly the provision of consistence between planning and decision-making**. Accordingly, we have not identified any contradictions among the specific sub-objectives of the National Programme. The measures are complementary to each other, the different waste types produced in the various facilities will be managed and disposed in the different existing facilities. Decisions will be taken at the moment when required and when the then state of technical development can also be helpful. Therefore, the internal consistency is adequate.

4 ASSESSMENT OF ENVIRONMENTAL IMPACTS OF THE NATIONAL PROGRAMME

The analysis of the environmental impacts and environmental risks of the activities specified in the National Programme (operating facilities and planned interventions) has been performed in the fields of radiology and conventional environmental protection.

4.1 The current environmental situation

In the presentation of the current environmental situation, special attention was focused on the environmental elements/systems related to the programme, describing any potential environmental conflicts and problems. In accordance with the expectation of the law, the potential future environmental situation must be presented also for the case when the plan or the programme is not implemented. There is a special situation in this case since the Programme considers basically the operation of existing facilities, and presents the necessary developments and expansions. So non-implementation of the Programme will result in non-performance of the latter (expansions/developments), in which case the situation remains identical to the current state.

4.1.1 Radiological situation

The radioactive waste disposal facilities operating in Hungary have environmental, establishment and operating licences, and they operate in accordance with the criteria specified in them and complying with the international regulations. Their establishment was preceded by an environmental baseline assessment, including the recording of the environmental radiological base level as an essential part of it, which serves as a reference for the evaluation of the results obtained during the operation of the disposal facility and the official controls.

4.1.1.1 National Radioactive Waste Disposal Facility

The NRHT located in Bátaapáti organises and performs its environmental and emission control activities in accordance with the requirements of the Environmental Control and Emission Control Regulations approved by the Central Transdanubian Inspectorate for Environmental Protection, Nature Conservation and Water Management[20].

The so-called base level, the pre-operation background values were specified as the key parts of the environment of the disposal facility before the establishment and the commissioning. The results of the control measurements annually performed in accordance with a programme are compared also to this data.

Gaseous radioactive emissions from the facility are allowed only under control via the control points. Measurements/samplings made at the control points of the atmospheric emissions are as follows:

- continuous environmental dose rate measurement,
- continuous aerosol sampling, average monthly gamma- spectrometric measurement, average annual alpha-spectrometric measurement, and ^{90}Sr activity concentration determination,

[20] Currently, it is the Environmental Protection and Nature Conservation Department of the Government Office of Fejér County.

– ^{3}H activity concentration measurements every 2 months on an average,
– ^{14}C activity concentration measurements every 2 months on an average.

Sampling is continuous, and the measurements are performed on the samples taken with the relevant frequency in radiometric laboratories.

Three 12 m^3 containers were installed on the basement level of the technological building for the collection and control of the wastewater. Samples are taken after stirring the content of the container designated for emptying. The samples can be analysed in a laboratory. The activity concentrations of the beta and gamma radiation radionuclides in the samples are specified with gamma spectrometric analysis and radiochemical procedures. The (gamma-spectrometry and tritium) measurements providing quick information and used for screening purposes are performed after the sampling, and the time-consuming tests demanding radiochemical preparations are performed on annual average samples. The waters are qualified after the radiological control. Waters that may be released are emptied into the sewer system of the building. Wastewater qualified as radioactive waste is processed by means of a mobile cementing unit.

The operator of the waste disposal facility performs an extensive radiation protection control with the intention to obtain information on the radiation conditions of the site, the radiation exposure of the staff and the radioactive contents of the environmental media of artificial origin to make sure that the disposal facility operates safely due to the measures taken on the basis of this information, and thereby the radiation exposure of the operating staff is kept at the minimum reasonable level within the permissible limits, and that the environmental impacts are minimised.

The radiological examination covers the following environmental elements:[21]

- in situ gamma spectrometric study of the soil in the vicinity of "A" type stations,
- collection, processing, chemical exploration of samples of soil, plant and animal origin, measurement of isotope-selective activity for alpha and beta radiation isotopes and gamma spectrometric measurements,
- groundwater level, isotope composition, activity concentration, chemical composition,
- water and sediment activity concentration in surface watercourses, chemical composition
- water chemical analysis of the water of the rainwater shaft and measurement of activity concentration,
- water chemical analysis of the effluent of ROCLA and measurement of activity concentration,
- isotope-selective activity measurement of the air in the vicinity of the disposal facility (of the filter of the aerosol meter) for alpha and beta radiation isotopes as well as gamma spectrometric measurements,
- ^{3}H, ^{14}C activity concentration measurement of the air in the vicinity of the disposal facility,
- fall-out / wash-out sampling and activity concentration measurement,
- activity measurement of the aerosol meter filter of the atmospheric emission point (air handling chimney), and activity concentration measurement of ^{3}H, ^{14}C.

Based on the results of the studies performed in the vicinity of the NRHT, it is found that the radioactivity of the vicinity of the site has not detectably changed in comparison to the baseline

[21] Source: Report on the operation of the NRHT in 2011, BA/0025-001/2012 (February 2012)

condition. No artificial radioactive substance deriving from the disposal facility was detected in the vicinity of the site. Both liquid and gaseous emissions are sampled and measured in connection with the control. The measurement results confirm that the emission limits specified by the relevant environmental authorities are fully met, the activity of the issued radionuclides is below one hundred thousandth of the permissible limits. It is found that **the operation of the disposal facility does not cause any extra load above the natural background on its environment from a radiological aspect.**[23]

4.1.1.2 Radioactive Waste Treatment and Disposal Facility of Püspökszilágy

The operating licence of the RHFT provides that an emission control system must be operated for the determination of the radioactive emissions. The radioactive emissions of the facility must be controlled in accordance with the contents of the Emission Control Regulations approved by the Central Danube Valley Inspectorate for Environmental Protection, Nature Conservation and Water Management[22]. An environmental control system must be operated for the control of the environmental impacts of the radioactive emissions. The environment of the facility must be controlled in accordance with the contents of the Environmental Control Regulations approved by the Inspectorate. During the operation, the possibility of an official control and simultaneous official sampling must be provided within the emission and environmental control in accordance with the legislation and the regulations.

Environmental monitoring is an integral part of the radiation protection control system of the RHFT. It is intended to explore the environmental impacts of radioactive waste treatment and disposal performed at the site and any pollution deriving from the work in due time. Sampling performed for measurement purposes involves the whole area of the site, and a 20 km zone in the case of surface watercourses.

The so-called base level, the pre-operation background limit-values had been specified at the key points (Némedi Creek, Szilágyi Creek, fish pond, rainwater reservoir, observation wells) in the vicinity of the disposal facility before commissioning. The results of the control measurements annually performed in accordance with a programme are compared also to these data specified in 1976-1977.

The environmental control activity related to the RHFT consists of the work of several laboratories. The own environmental laboratory of the RHFT performs the fundamental major measurements. Special measurements, detection of isotopes difficult to detect in the environmental samples are performed by contracted partners. These examinations cover the following:

- Determination of the radioactive gas content of the air with combined tritium/radiocarbon samplers,
- Determination of the radioactivity of the soil:
  - Determination of the ^{90}Sr content of soil samples;
  - In-situ gamma spectrometric measurements;
- Determination of the radioactivity of the flora and fauna:
  - Determination of the ^{90}Sr content of plant samples;
  - Determination of the ^{90}Sr content of samples of animal origin;
- Control of surface watercourses:

[22] Currently, it is the Environmental Protection and Nature Conservation Department of the Government Office of Pest County.

  - Determination of the ^{90}Sr content in the sludge of the rainwater reservoir, ditch and surface waters;
  - Determination of the ^{14}C and ^{90}Sr contents of surface waters;
- Control of the groundwater:
  - Sampling of the groundwater and ^{14}C test by operating "Radaqua" automatic water samplers;
  - Determination of the ^{14}C, ^{3}H and ^{90}Sr contents of the groundwater samples;
  - Determination of the ^{3}H content of the groundwater samples with low detection limits.

Annual reports with contents specified in Section 1.9 of Annex 4 must be made on radioactive emissions into the air and the water during the use of nuclear energy on the basis of Section 6(2)(d) of Decree 15/2001 of 6 June 2001 of the Minister for Environmental Protection and in accordance with the requirements of the environmental operating licence of the RHFT, and submitted to the Inspectorate.

The following statements can be made on the basis of the data given in the annual reports:

- No artificial isotopes deriving from the site were detectable in the aerosol and fall-out samples taken in the vicinity of the RHFT, and the gross beta activities meet the zero levels of 1976.
- Studying the activity concentration values of the sludge, soil, animal and plant samples it is found that no radioisotopes deriving from the site are detectable in the soil, sludge, animal and plant samples taken on the area of the RHFT, and the gross beta activities meet the zero levels of 1976.
- The results of the in-situ measurements made at the site of the RHFT confirm that the natural radioactivity in the direct vicinity of the waste disposal facility has not changed and has not exceeded values measured on other parts of the country.
- The gross beta activities of the tested groundwater samples do not exceed the levels before the establishment of the disposal facility. The ^{90}Sr activity concentration of the tested water samples is low, mostly below the detection level.
- Only isotopes present also in the background are registered in the gamma spectra of the tested samples. No radionuclides deriving from the waste disposal facility or from other anthropogenic sources could be detected.
- Slight fluctuation can be observed in the ^{14}C activity concentration of the waters, no definite trend was detected except for well Psz-54. From April 2004, a slow but systemic increase of the specific activity of ^{14}C has been observed in well Psz-54, which exceeded the value characteristic of today's surface waters in 2009 and 2010, but the activity concentration is so low that it does not indicate an environmental radiation exposure.[23]

Increased tritium levels were observed in the vicinity of the RHFT on two occasions during the operation of the environmental monitoring system after its commissioning in 1976. First in 1991-1992, when the "disturbed" background related to the licensing of the operation of "A" type storage cells installed as an expansion was measured, and secondly, between 1999 and

[23] Source: Results of the assessment of the environmental impacts of the radioactive disposal facilities, RHK Kft., http://www.rhk.hu/wp/wp-content/uploads/2011/04/kornyezeti-eredmenyek-2010.pdf

2001, when the tritium activity concentration in well "C" built on the disposal area increased up to ca. 3000 TU with the increase of the water level, then started to slowly decrease.[24]

In 2003-2004, the RHK Kft. implemented a research programme to define the origin of the tritium level detected at the site of the RHFT. Based on the tritium content of the drill samples it was found that the activity concentration of tritium reached the maximum level at 4-14 m depths, therefore penetration accumulation depth characteristic of "A" type disposal facilities is assumed. This assumption is further supported by the fact that the tritium activity of the moisture content of the soil sample taken from the bottom of the pit in the north-western corner of the 4th line of basins was 10^5 Bq/l[25]. Works intended to accurately locate the source of the tritium pollution were continued in 2005.[25]

Based on the measurements, it was concluded that leakage from cells in the western third part of the 1st line of cells was the highest (as regards tritium), but high tritium concentration was measured also at the eastern and central dilatations. The reconstruction of the cells was recommended in the report to eliminate the tritium anomaly detected at the site. The extra high values measured in well "C" from the mid of 2007 are connected with the cell exploration operations. The increase of the tritium content of the well accelerated in the mid of 2010, which coincided with the fast rise of the water level in the well again. The highest ever tritium concentration was measured in the winter of 2010/2011 (≈ 880 Bq/dm^3), and subsequently, both the water level and the tritium concentration of the well were continuously decreasing in 2011 and 2012. Close to the end of year 2012, the tritium concentration was one fourth of the winter value of 2010/2011. The well located at the site is not used for the supply of drinking water, it does not entail environmental radiation exposure.[26]

The distribution maps drawn on the basis of the tritium contents of the water samples clearly indicate that the tritium content of the groundwater in the zone of the disposal facility has reduced in the recent years, no tritium exposure is detectable outside the site, and therefore the groundwater in the vicinity of the disposal facility does not cause an environmental radiation exposure.

In summary, it can be concluded that **on the basis of the results of the examinations made in the vicinity of the RHFT, the radioactivity of the vicinity of the site has not increased in comparison to the baseline values obtained in 1976-1977, except for tritium measured in the groundwater - in a volume negligible from the aspect of radiation protection - which is fluctuating within the site.**

The measurement results of the environmental samples were recorded in the local and national (OKSER) computer system.

4.1.1.3 Interim Spent Fuel Storage Facility

The KKÁT organises and performs its environmental and emission control activities in accordance with the requirements of the Environmental Control and Emission Control Regulations approved by the Southern Transdanubian Inspectorate for Environmental Protection, Nature Conservation and Water Management[27]. Environmental control by the KKÁT covers the following four areas:

[24] Source: Determination of the origin of the tritium leakage of the RHFT of Püspökszilágy, Isotoptech Zrt., 2004.
[25] Source: Accurate localisation of the source of tritium pollution detected on the disposal areas of the RHFT of Püspökszilágy, Isotoptech Zrt., 2005.
[26] Source: The environmental monitoring assessment of the RHFT of Püspökszilágy in 2012, MTA ATOMKI, 2013.
[27] Currently, it is the Environmental Protection and Nature Conservation Department of the Government Office of Baranya County.

- control of the environmental impacts of atmospheric emissions,
- control of the environmental impacts of liquid emissions,
- control of subsurface waters,
- measurement of direct and diffuse gamma radiation originating from the facility.

The environmental radiation protection control system and sampling programme of the KKÁT are integrated into the operational environmental radiation protection control system of the nuclear power plant. Thereby the individual measurement results also constitute the database of the whole system, and it is worth highlighting only some of them (data of the dose rate measured on the area of the KKÁT, of the rainwater shafts and the groundwater tritium activity concentration).

As regards the measurement results of the telemeters installed in the vicinity of the KKÁT and the activity concentration values of the samples taken, it is concluded that no impact of the KKÁT on the radioactive concentrations of the environmental media and on the dose rate of the environmental radiation is detectable. Adherence to the dose restriction specified for the reference (critical) population group can be confirmed with measurements performed during the emission control and with spread and radiation exposure calculations based on emission and meteorological data.

The extra radiation exposure of the critical population group calculated from the KKÁT emission limit-value criterion is some nSv/year on the basis of data given in annual reports related to the operation and safety of the KKÁT, which does not reach one thousandth of the permissible dose restriction value.[28]

4.1.2 Conventional environmental factors

4.1.2.1 Air climate

Air quality

The air quality of the environment of the three existing facilities is characterised on the basis of the immission data of the Hungarian Air Quality Monitoring Network (HAQMN),[29] and the results of the targeted air pollution measurements previously performed in connection the key emitters and the studied facilities.

In accordance with Decree 4/2002 of 7 October 2007 of the Minister for Environment and Water on the designation of air pollution agglomerations and zones, all the three concerned settlements and their neighbouring settlements belong to air pollution agglomeration 10 ("The other areas of the country"), which is classified into the following zone groups in relation to the different air pollutants:

- PM_{10}: **"E"** (the air pollution level is between the upper and the lower assessment thresholds)
- PM_{10}-benzo(a)pyrene (BaP): **"D"** (the air pollution level is between the upper assessment threshold and the limit-value related to the air pollution value)
- ground-level ozone: **"O-I"** (the concentration exceeds the target value)
- it is the least polluted as regards the other pollutants; **"F"** (the air pollution level does not exceed the lower assessment threshold).

[28] Source: Annual reports related to the operation and safety of the KKÁT, RHK Kft.
[29] Source: www.levegominoseg.hu

The fact that the air pollution of the areas in question is low is supported also by the data of the HAQMN. Last year's characteristic data of the measuring stations nearest to the individual facilities, as the crow flies, is summarised in the following three tables.

Table 4-1 **Automatic and manual measuring stations nearest to the individual facilities**

Place of facility	**Place of measuring station**	**Type of measuring station**	**Measured pollutants**
Paks Bátaapáti	Baja*	manual	nitrogen dioxide
	Paks**	manual	airborne dust
	Kalocsa**	manual	nitrogen dioxide
	Komló	automatic	sulphur dioxide, nitrogen dioxide and nitrogen oxides, airborne dust, carbon monoxide, ozone
	Szekszárd	manual	nitrogen dioxide
Püspökszilágy	Vác	automatic, manual	sulphur dioxide, nitrogen dioxide and nitrogen oxides, airborne dust, benzole, carbon monoxide, ozone

* *Relevant measuring point only in the case of Bátaapáti.*
* *Relevant measuring point only in the case of Paks.*

Table 4-2 **Air pollution indexes near the areas affected by the interventions in 2014**

	SO_2	**NO_2**	**NO_x**	**PM_{10}**	**AD**	**Benzole**	**CO**	**O_3**
Baja	-	Good	-	-	-	-	-	-
Kalocsa	-	Excellent	-	-	-	-	-	-
Komló	*	*	*	*	-	-	Excellent	*
Paks	-	-	-	-	Good	-	-	-
Szekszárd	-	Good	-	-	-	-	-	-
Vác automatic	*	*	*	Good	-	*	*	*
Vác manual	-	Good	-	-	-	-	-	-

* The data set cannot be evaluated for 2014
The combined evaluation is always made by qualifying the component with the worst results.
The pollutant in question is not measured where it is not indicated.

Table 4-3 **Numbers of exceedances of the limit-value on the assessed areas in 2014**

	SO_2	**NO_2**	**PM_{10}**	**Benzole**	**CO**	**O_3**
	hourly/daily/yearly	hourly/daily/yearly*	daily/yearly	daily/yearly	hourly/every 8 hours/yearly	every 8 hours
Baja		**8**/-				
Kalocsa		**1**/-				
Komló	**	**	**		-	**
Szekszárd		**8**/-				
Vác automatic	**	**	16/-	**	**	**
Vác manual		-				

* In the case of the manual measuring points, the number of exceedances of the hourly limit-value is not indicated.
** No valuable data is available.
Exceedances of limit-values above the permissible number are in bold.
Paks is not included in the table as there is no valid limit-value for airborne dust.

Considering that the **disposal facilities are already existing and operating sites**, except for the deep geological disposal facility to be established in the distant future at a location not known at the moment, **the assessed activities affect also the current situation**. Concrete data related to

the status without any activity is available only in the case of the facility of Bátaapáti established recently. The major characteristics of the individual facilities are as follows:

- ***National Radioactive Waste Disposal Facility:*** There are no significant air polluting sources in Bátaapáti and its vicinity. The nearest settlement considered significant from the aspect of emission is Bátaszék, the impact of which is negligible. Transport and heating are the key air pollutants in the neighbouring small settlements, and occasionally agricultural activities might cause dust pollution. Potential pollutions might settle in closed and poorly ventilated valleys as a result of the relief.

  Based on measurements made in 2002, 2003 and 2004 before the commissioning of the disposal facility[30], the basic air pollution is extremely low. In regard to carbon monoxide and nitrogen dioxide, the measured concentrations vary in the range of background pollution, the impacts of transport and, in winter, of heating are detectable. As concerns airborne dust, the valid limit-value has not been exceeded in any case. The impacts of the local sources were confirmed by the results, and higher values were typical in summer. Airborne dust has not reached the limit-value either.

  The emissions of boilers with capacities below 140 kWth used for the heating of the buildings and the draw-in air flow, the ventilation system, the concrete plant and the equipment and transport vehicles necessary for its operation are the operational air pollution sources related to the disposal facility. (The containers are placed for example with a diesel powered trailer and a fork-lift truck in the disposal space.) The air polluting impact of these sources cannot be detected on the nearest residential areas. Transport emissions are caused by one or two waste consignments per day from the Paks Nuclear Power Plant, the supply of basic materials (1-2 vehicles per day), and the personnel traffic, which is max. 15-20 cars per shift (there are three shifts), including visitors. Therefore the extra exposure resulting from road transport is negligible.

- ***Radioactive Waste Treatment and Disposal Facility of Püspökszilágy:*** Püspökszilágy and the settlements within the close vicinity (Kisnémedi, Galgagyörk, Őrbottyán, Püspökhatvan, Váchartyán, Vácrátót) are agrarian. In addition to the agricultural lands, the presence of forests is determinant in the region. No significant industry has been settled in the region, there are only small plants here and there, and there is a larger industrial and commercial area between Vácrátót and Őrbottyán. The air quality of the settlements is affected mainly by traffic (local and transient) and heating (natural gas and solid fuel and wood heating at small settlements). The local relief formations of the area, the system of north-western and south-eastern direction valleys contribute to the ventilation of the area, the chance of atmospheric inversions is relatively low.

  There are no air polluting sources emitting conventional air pollutants. (The thermal input of the boiler used for heating does not reach 140 kW.) The technological building is provided with a centrifugal fan equipped with a two-stage aerosol filter for any event of emergency, which may have significance in connection with radiological emissions. Several machines (e.g. forklift) operate in one shift, in the daytime shift at the site. Transport related to the technology involves only one or two vans per week, and the passenger traffic (including visitors) is limited to 15-20 cars per day. Therefore road traffic is not considered an essential emitter in view of the air quality. The roads located within the site or leading to the site are provided with dust-free pavement.

[30] Source: Drawing of documents related to the licensing of establishment of the disposal facility intended for the final disposal of low and intermediate level radioactive waste of the nuclear power plant - Final disposal of low and intermediate level radioactive waste of the nuclear power plant in the subsurface disposal facility planned in the region of Bátaapáti - Environmental impact study (ETV-Erőterv Zrt., 2006)

In 2004-2005, air quality measurements were made during the analysis of the environmental impacts of the facility[31]. According to the results, the nitrogen dioxide concentrations are significantly lower than the health limit-values. (Naturally, this value is slightly higher in winter than in summer.) The concentration of the airborne dust is also significantly lower than the then valid requirement.[32] (The results are even lower in winter than in summer.) This situation has not substantially changed since then.

– ***Interim Spent Fuel Storage Facility:*** The Paks Nuclear Power Plant and the Interim Spent Fuel Storage Facility constituting its part are located far from residential areas (5 km from the centre of the town of Paks), on a plain area, 1 km from the Danube. It is surrounded by a protective forest and agricultural lands, and the nearest residential area is several kilometres away, on the other side of the Danube.

  The neighbouring settlements were originally of agricultural nature, and later they changed over mainly to the service of the power plant. Traffic and industry are the main emission sources in the vicinity of the power plant. The impact of heating is not significant due to the distance heating provided by the power plant.

  The operation of neither the power plant,[33] nor the Interim Spent Fuel Storage Facility contributes substantially to the industrial emissions due to the absence of significant emission sources.

  Measurements were performed in several different measurement periods in 2012 and 2013 during preparations made for the establishment of the new nuclear power plant blocks, at several locations, to determine the nitrogen dioxide, nitrogen oxide, sulphur dioxide, carbon monoxide, ozone, airborne dust, total suspended particulate matter (TSPM) and airborne dust concentrations. Their results[34] were similar to the immission values obtained during the assessment made in 2003 (at less locations and for less measured pollutants). The values are excellent for sulphur dioxide and carbon monoxide and good for the other parameters:

  - The SO_2 concentrations were mostly low, amounting only to several percent of the relevant limit-values, and the CO immission values were also much below the limit-value.
  - The results of the NO_2 immission measurement indicated that the area is characterised basically by a lower concentration, however, exceedances of the hourly limit-value occurred mainly in the morning hours along the traffic routes (e.g. access road to the power plant). There was no exceedance of the 24-hour limit-value. During the six months of heating, higher values were measured. (Similar feature was observed also in the case of NO_x which is no longer regulated with a health limit-value.)
  - The 8-hour moving average concentration of ozone exceeded the limit-value only in one case and to a minimum extent.
  - As regards airborne dust, the daily limit-value was exceeded at each measuring point, mostly on the area of the power plant and the meteorological station. (In 2003, it was attributed to the loose sandy soil of the area.) The permissible number of yearly exceedances of the limit-value is not assumed on the basis of the measurement data.
  - Contrary to PM_{10}, the TSPM concentration exceeded the previous health limit-value - which is no longer valid - only in one case.

[31] Source: Analysis of the environmental impacts of the RHFT of Püspökszilágy – Closing Report (ETV-Erőterv Rt., 2005.)

[32] It is no longer regulated with a limit-value.

[33] In fact, only the 14 diesel generators each operating less than 50 hours per year and used only as emergency power supply or as drive for the fire-fighting water pump are considered sources at the nuclear power plant.

[34] Source: Environmental impact study for the establishment of a new nuclear power plant at the site of Paks, MVM ERBE ENERGETIKA Mérnökiroda Zrt. 2013

- The measured values of airborne dust did not reach the previous limit-value at all, which is no longer valid.

Climate conditions

Climate change trends

The worldwide climate change (rise of temperature and sea level, melting of ice caps, change of the precipitation patterns and variations) could not be avoided by our country either. The following figures from the website of the Hungarian Meteorological Service (hereinafter referred to as HMS)[35] indicate the major changes in period 1960-2009. The figures show that **the places of the treatment and disposal of radioactive waste are not free from changes either**.

According to the individual characteristics, the changes can be summarised as follows:

– **Temperature**: Based on the data of the HMS and studying the recent 30 years, the increase of the winter and autumn average temperatures is not significant, however, the spring average temperature has increased by 1.75 Celsius degrees, and the summer one has increased by almost 2 Celsius degrees. In addition, the fact that extreme hot weather situations have become more frequent since the eighties is obvious.

– **Probabilities of precipitation, evaporation, flood and drought:** The change of the annual precipitation variations is not considered significant. If the analysis is broken down to seasons, there is no change detectable in the summer, autumn and winter periods, however, the reduction in the spring that has the greatest importance from an ecological aspect is significant, and approaches 20 % if the last century is studied.

Figure 4-1 **Territorial distribution of the changes of the annual average temperatures in 1960-2009**

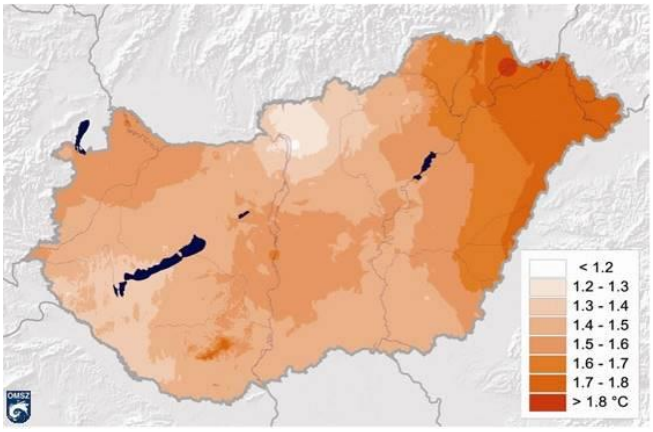
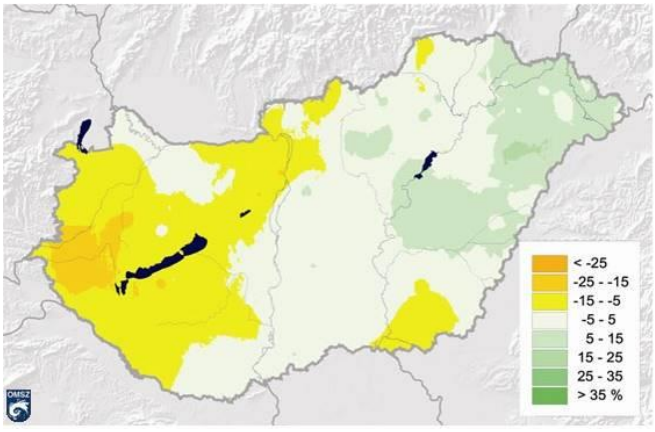
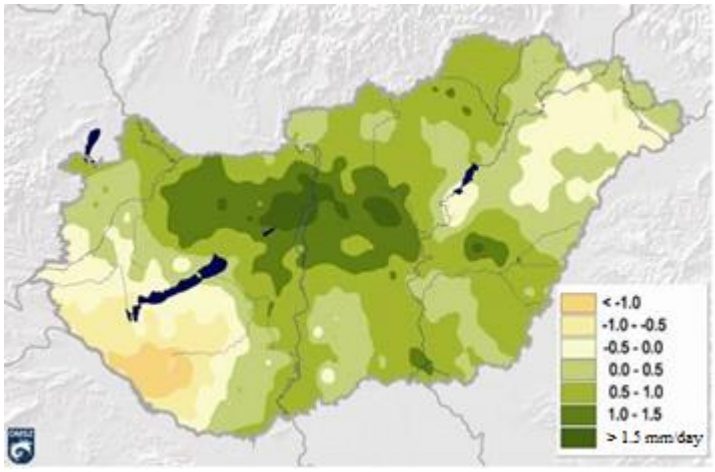


Figure 4-2 **Changes of the annual rainfall in % in period 1960-2009**



[35] Source: www.met.hu

Figure 4-3 **Changes of the summer average daily rainfall intensity in period 1960-2009**



In addition, the length of dry periods has significantly increased since the beginning of the 20th century. The number of days with rainfalls above 20 mm has also slightly increased, while the daily intensity of rainfall in the summer period has shown significant increase. These figures indicate a tendency according to which rainfalls will reach the country in the form of intensive showers lasting for short periods.

Changes expected in the future

According to the forecasts, changes entailing more and more severe consequences are expected in the future. More or less different so-called climate scenarios with uncertainties have been made for the analysis of the expected changes. However, the global climate models are not suitable for the evaluation of smaller areas such as Hungary or even country parts within it. This is why there are only a few (and careful) forecasts available for Hungary. The PRUDENCE and CarpathCC projects are such models made from EU aid for smaller areas. The PRUDENCE project[36] assumes less precipitations but in the form of torrential rainfalls during the summer in the central and southern parts of Europe. The annual precipitation volume in Hungary accompanying the global warming by 1°C by 2025 remains, in fact, unchanged according to the model. (Some increase or decrease with the same probability rate might be possible.) At the same time, there will be a significant variation of the temporal distribution of the precipitation volumes. There will be substantive reduction in summer and similarly substantive increase in winter, which will result in a significant water loss in the long term due to the limited infiltration during the winter period. Changes expected in the annual precipitation pattern are confirmed by all model runs but to different extents.

Various modellings with regional climate model adaptations were made also in our country. In view of the deviations, we do not want to present the numeric results of one or two actual modellings, but are going to concentrate on general findings supported by most models. The following table summarises the results of 4 regional models used in the HREX report titled Changes of Climate Extremes in Hungary: Recent time and Future made by the Hungarian Meteorological Service and Eötvös Lóránd University and of the 11 models contained in Policy Discussion Paper titled Second National Climate Change Strategy 2014-2025 with Prospects for 2050 (Hereinafter referred to as NCCS2):

[36] Sources: www.prudence.dmi.dk

Table 4-4 **Predictions of the HREX Report and the NCCS2**

	HREX				NÉS2			
	spring	**summer**	**autumn**	**winter**	**spring**	**summer**	**autumn**	**winter**
number of heatwave days	+				+			
number of frosty days	-				-			
max. length of dry period	+(by the end of the century)	+	+(by the end of the century)		+	+(by the end of the century)	?	-
rainfall change					-	-	+	+
number of days with heavy rainfalls	+		+	+				
rainfall intensity	+		+	+(by the end of the century)			+	+

Source: Own edition on the basis of data from HMS, ELTE, NCCS2 (+ increase, - decrease)

The increase of the number of heatwave days and the decrease of frosty days are expected as a result of global warming. The standard deviation of the precipitation estimates is substantially higher than the uncertainty of the temperature forecasts. The previously mentioned 11 models predict only a slight change of the rainfall volumes by the mid of the century, however, an increase by 15-20 % is predicted for winter and a decrease by 10-30 % for summer by the end of the century.

According to the modelling, despite the small area of our country, the changes observed on the area of the country will not be uniform, **a temperature increase in north-western and south-eastern direction and a precipitation decrease in the same direction are expected**.

Despite the uncertainties, the impacts of the climate change will be obviously observed also in the vicinity of the radioactive waste treatment and disposal facilities to a more or less extent, and are expected to be observed to an increasing extent in the future. The exposures of the individual facilities to the individual climate impacts and their sensitivity to such impacts are discussed in Chapter 4.3.

4.1.2.2 Water

The conditions of surface and subsurface waters in the vicinity of the individual facilities are summarised as follows:

– ***National Radioactive Waste Disposal Facility:*** Waters from precipitations falling onto the hillside of Geresd are led off from the surface by the water courses creating and still forming the valleys. The surface waters of the hillside are divided into three large water systems:
  - The waters of Rák Creek and of the areas west of it flow into Völgység Creek and then through this creek into Sió Canal and finally into the Danube.
  - From the southern areas they are collected and led by Belsőrét Creek, Véménd Creek, Bozsok Creek and Csele Creek (as separate watercourses) into the Danube.
  - From the northern part of the hillside of Geresd, the waters of Huta Creek, Kövesd Creek and of the side creeks flowing through Mórágy are collected and led by Lajvér Creek into the Danube.

  The surface watercourses are characterised by rapid flood waves caused by intensive precipitations.

  In accordance with the classification specified in Government Decree 219/2004 of 21 July 2004 on the protection of subsurface waters, highly sensitive, sensitive and non-sensitive

areas are scattered in a mosaic form in the region. However, the direct vicinity of the surface facilities does not belong to either highly sensitive or sensitive areas.

The movement of groundwater is significantly affected by the diversified relief and the rapidly deepening valleys. The fallen precipitation (remaining after evaporation) rapidly leaks down from the unsaturated zone of the hill tops and comes up to the surface due to the drainage effect of the deep valleys. In the vicinity of the site, the subsurface water flow system is drained mainly by Huta Creek, Lajvér Creek and Mórágy Water. The first significant subsurface aquitard is the upper weathered zone of the granite block of Mórágy. On surfaces where the drainage effect of the surface relief is limited the draining waters reach the granite zone. The weathered part of the granite zone absorbs the subsurface waters to a certain extent, but as the dense granite is reached at a lower depth the drainage of the waters significantly reduces. The boundary zone of the dense granite modifies the movement of the subsurface waters, the infiltrating water moves laterally in the zone of the weathered granite.

In deeper flat valleys, the groundwater level is at 0-1 metre at some places where the groundwater evaporation is detectable also in the water level of the observation wells during the summer period. In rainy periods, the groundwater appears also on the surface, the valley bases are often watery. The originally watery valleys have been regulated with drainage basin cut-ins at several places (e.g. Nagymórágy Valley).

- ***Radioactive Waste Treatment and Disposal Facility of Püspökszilágy:*** The close vicinity of the RHFT belongs to the catchment area of Galga. The table-land where the site is situated is bordered by Szilágy Creek to the northeast, and by the valley of Némedi Creek to the southwest. Waters from these two creeks are led by Galga to Tiszta River. In addition to the bordering two creeks, there are also several small watercourses (Hartyáni Creek, Bara Creek, Gombás Creek) a bit farther from the site.

  The groundwater levels are significantly affected by the relief as well as the soil and geological conditions on the area. The site is located on an elevated surface, and the groundwater level is deeper than 20 m with reference to the surface in some cases.[37] In wet periods, the groundwater level rises also in the comb zone, however, due to the roof position of the facility, in fact, there is never direct connection between the technical facilities of the site and the groundwater.

  Karst areas from the Triassic period may occur also on the surface west to the area, near the Danube. These can be found in the depth under the assessed area along the slides of significant sizes. There are rather thick aquitard deposit lines from the Triassic period on the karst layers, and therefore the surface waters and the groundwater of the area are not connected with the karst waters. These latter are located at nearly 1000 m depth on the area. In practice, no stratum water can be exploited from the Triassic set, and the drilled well of the area depleted decades ago.

- ***Interim Spent Fuel Storage Facility:*** Based on the Hungarian Catchment Area Management Plan (HCAMP), the following surface water bodies can be distinguished in the vicinity of the site of Paks. The Danube, Csámpa Creek, Paks-Fadd Main Canal, Fadd-Dead Danube, fish ponds of the Paks Anglers Association as well as Szelid Lake belonging to the Kiskunság National Park, which is a nature conservation area.

  The direct right-bank catchment area of the Danube occupies the eastern band of Southern Mezőföld and Northern Sárköz. The mainly NNW-SSE small creeks carry their waters either directly into the Danube or the dead branches of the Danube. These include also Csámpa Creek located 2 km west of the site, which empties into the Paks-Fadd Main Canal. The

[37] Based on the definitions, this would not be groundwater, however, due to the special relief conditions, the first water layer below the surface could be considered groundwater irrespective of its depth.

surface waters on the left bank of the Danube do not belong to the direct impact area of the site.

According to Annex 2 to Decree 28/2004 of 25 December 2004 of the Minister for Environment and Water specifying the water quality protection area categories of the surface waters, the surface waters of the vicinity of the site - such as the affected Danube section as well as other flowing and standing waters - belong to the generally protected category.

Subsurface water bodies located in the region of the site are as follows: Danube right bank catchment area under Paks (sp.1.10.1 shallow porous), Bölcske-Bogyiszló-bay (sp.1.10.2. shallow porous), Danube right bank catchment area under Paks (p.1.10.1, porous), Bölcske-Bogyiszló-bay (p.1.10.2 porous), Western Great Plain (pt.1.2. porous thermal).

The shallow porous water bodies located on the catchment area of the Danube right bank under Paks as well as in the Bölcske-Bogyiszló-bay are constituted by the groundwater in the water-borne deposits of the Danube, its volume and chemical conditions are good.

Porous water bodies on the catchment area of the right bank of the Danube section below Paks as well as in the Bölcske-Bogyiszló-bay are shallow stratum waters in the upper part of the Upper Pannonian deposits not deeper than 500 m. The volume and chemical conditions of these water bodies are good.

The porous thermal water body reaching from the Western Great Plain under the Danube to the southern part of Mezőföld is constituted by thermal waters that can be obtained from the sandy layers of the Upper Pannonian sediments located deeper than 500 m. Their chemical conditions are good, however, their volume is not sufficient, since a significant water level sinking is observed due to water uses exceeding the rate of natural supply.

In accordance with Section 2 (c) of Annex 2 to Government Decree 219/2004 of 21 July 2004 on the protection of subsurface waters, the vicinity of the Paks Nuclear Power Plant is considered a sensitive area from the aspect of the condition of the subsurface waters, since the top of the porous main water supply formation is within 100 m under the surface. The average depth of the groundwater of the area is 8-10 m.

4.1.2.3 Earth, soil, conventional waste

Earth, soil

The characteristics of the soil and geological formations at the individual facilities are as follows:

- ***National Radioactive Waste Disposal Facility:*** The major formation of the vicinity of the site is the paleozoic Granite Formation of Mórágy, which is the main formation of the Mórágy block. The Mecsekalja belt constituted by the metamorphic rocks of the Ófalu Formation is located northwest of the studied area. The outlines of the original magmatic body constituting the Mórágy block are unclear, only its northwest boundary line of tectonic nature is defined. It is assumed that the subsurface extension is larger than the current 7x18 km surface extension. The paleozoic formations are covered by Quarternary deposits (on hills) and Pannonian deposits (at the edges). The paleozoic formations emerge onto the surface only in valleys with steep walls. The upper 50 m of the granite rock is weathered, weathering is gradually decreasing downwards and then it ends. It has a major role in the formation of the hydrogeological conditions. The magmatic formations of the granite formation are densely woven by rills of hydrothermal origin, the directions and thickness of which are rather varying. No Quarternary breaks are found on the area. During the geodezic monitoring of the Mecsekalja belt bordering the area, no movement has been observed in the recent 20 years.

Clayey-silt-laden brown earth, Ramman's brown earth, and alluvial soils in the creek valleys are the major genetic soil types of the region. Clay loam is the dominant physical soil type. Based on their chemical reaction, slightly acidic soils are dominant, and are of carbonate nature from the surface in the creek valleys. The soil forming rock is constituted by monzogranite, monzonite, aplite, microgranite, granite porphyry[38], while soils formed on loess deposits occur in the northern third part of the area, and soils formed on Tertiary and older deposits occur in the western part. Based on their water balance properties, the soils have medium water intake and conductivity, high water storage and good water-bearing capacities. Their organic matter content is 50-100 t/ha, while in the case of soils formed on loess this value is 100-200 t/ha. The thickness of the topsoil is 40-70 cm (on areas characterised by granite) and above 100 cm (on loess areas). On the poorest areas, the soil value mark is between 20 and 30, but is typically between 40 and 50, and reaches 50 to 60 towards north.

- ***Radioactive Waste Treatment and Disposal Facility of Püspökszilágy:*** The studied area is located in the south-western part of Cserhát, the narrow vicinity of the site is constituted by the table-land emerging between Szilágyi Creek and Némedi Creek. The Upper Oligocene Szécsényi Schlier emerging on the surface only on the steep sides of some creek valleys is the oldest surface formation on the area. The Oligocene and Lower Miocene sediments are crossed by veins of formations of the Mátra Andesite at several places, including Malató Mountain of Püspökszilágy. Beyond the above formations emerging on the surface in mosaic forms, Quarternary deposits dominate on the surface. Loess is the dominant loss in the latter. Slope mass movements (landslides, soil movements) have a significant role in the surface formation of the area, as a result of which redeposition and restratification of the deposits occur at several places.

  Ramman's brown earth and the clayey-silt-laden brown earth are the dominant genetic soil types of the area. Püspökszilágy is situated just at the border of the area characterised by the two soil types. Therefore the soils belong to the clay loam and loam categories on the basis of their physical classification. Based on their chemical properties, slightly acidic soils and carbonate soils from the surface occur on the loess and Tertiary or older soil forming rocks. Based on their water balance properties, the soils here can be classified into two types, and each is characterised by medium water intake and good water-bearing capacities, and they differ only in that some have medium while others have poor water conductivity capacities. The organic matter content of the soils is between 100 and 200 t/ha, the thickness of the topsoil is above 100 cm, while the soil value mark is between 40 and 50, and between 50 and 60 respectively.

- ***Interim Spent Fuel Storage Facility:*** The surface of the basement in the region of Paks is at ca. 1600-1700 m depth. According to our current knowledge, the base of basin under the power plant is constituted by slightly converted granite formations of the lower coal age (ca. 365 million years) belonging to the Mórágy Complex. Ca. 1000 m thick Miocene formations constituted partly by clastic deposits and partly by vulcanite settled on the surface of the crystalline basement. Rhyolite, rhyolitic tuff, andesite, clay marl, lime marl, sandstone, limestone are the main rock types. 600-700 m thick Pannonian beds cover them. The surface in the vicinity of the power plant is constituted by Quarternary formations everywhere. During the Quarternary period, the glacial (Pleistocene) loess formation was the most typical sedimentation process. The low flood plain is constituted by the deposits of today's Danube from the Holocene age. The upper part of the variably developing column is constituted by several metre thick flood mud, rock flour and fine sand almost everywhere. Under this,

[38] Geology of the north-eastern part of the Mórágy block (edited by: Zoltán Balla, László Gyalog, Budapest 2009. MÁFI)

fluvial small- and medium-grained sand is found down to 12-16 m depth, and 5-25 m thick sandy gravel and gravelly sand are found at the bottom. Several metre thick clay and turbary interbedding and lenses rich in organic matters also occur along the formerly cut dead-channels in the upper sandy level.

Humic sand soils dominate on the area, alluvial soils dominate near the Danube, and chernozem soils with lime incrustation dominate at the northern and southern edges of the area. Based on their physical properties, these are sandy loam, clay loam, and clay along the Danube. Based on their chemical properties, slightly acidic, and from the surface, carbonate soils occur. Glacial and alluvial sediments and loess deposits are the soil forming rocks. Based on their water balance properties, soils with very goods water intake and conductivity capacities, poor water storage capacities, very poor water-bearing and medium water intake and conductivity capacities, excellent water storage and good water-bearing capacities occur on the area. The organic matter content varies between 50 and 300 t/ha. The soil value mark is mostly between 20 and 60, and in the case of chernozem it is between 70 and 80.

Conventional waste

Waste treatment is included in the soil and geological chapter as the waste may pollute mainly this formation. Conventional waste generation in the individual operating facilities is summarised as follows:

- **National Radioactive Waste Disposal Facility:** Non-radioactive waste generated during the operation of the NRHT is collected and handed over to licensed organisations for treatment in a way specified in the environmental licence.
  - Communal waste is delivered by the local service provider to regional landfill of Cikó.
  - The volume of the generated non-hazardous waste is insignificant. Packaging waste, filter materials, cloths, protective clothing not polluted with hazardous materials are disposed on the landfill of Cikó.
  - Packaging waste, filter materials, waste oil, batteries and lab chemical waste containing only remnants of hazardous materials or polluted by them are generated as non-radioactive hazardous waste. They are collected and disposed in a normal way. Waste materials are recorded and reported in accordance with the relevant legislation.
- **Radioactive Waste Treatment and Disposal Facility of Püspökszilágy:** Non-radioactive waste is generated in negligible volumes during the operation at RHFT site of Püspökszilágy. Hazardous waste is generated in the environmental control laboratories, the offices, the service rooms and during maintenance. Their volume is not significant.

  Waste materials from the treatment of radioactive waste are considered industrial waste. These waste materials, such as the remnants and packaging of materials used within the controlled zone are generated only there. These must be treated together with the hazardous waste after the radiation protection control, and their volume is also insignificant.

  Paper, plastic, glass and green waste materials are selectively collected at the site. Conventional waste is not treated here. The collected waste is taken over to a licensed collector under a contract.

  Waste materials are recorded and reported in accordance with the relevant legislation.
- **Interim Spent Fuel Storage Facility**: Waste generated in the KKÁT and expected to be inactive is qualified by means of a preliminary radiation protection qualification. The waste materials are delivered together with similar waste of RHK Kft., if they are inactive, from the controlled zone directly to the Landfill of the Local Government of Paks, where they are mixed with the communal waste of the city and disposed in the same way.

Inactive production waste that may not be disposed on the communal landfill is delivered to the nuclear power plant in a way specified in the operating licence, where the hazardous waste is disposed in the interim storage facility of hazardous waste, and non-hazardous production waste is disposed at the collection site of industrial waste. So the inactive waste materials are collected, recorded by PA Zrt., which provides also for its delivery, utilisation/disposal. Materials from the KKÁT are received in the same way as waste materials from other areas of the nuclear power plant. Finally, the waste materials are handed over to a contractor having an environmental licence for the receipt and treatment of the waste, and part of them are incinerated in a suitable incineration plant.

4.1.2.4 Biota, ecosystems, with a special regard to protected natural and Natura 2000 areas

The existing facilities, the NRHT, the RHFT and the KKÁT do not directly affect either protected or Natura 2000 areas. However, Natura 2000 areas and the elements of the National Ecological Network (hereinafter referred to as the NEN) are found everywhere in the direct vicinity of the facilities, as it is shown by ***Figures 4-4 to 4-6***:

Figure 4-4 **The NRHT and its vicinity**

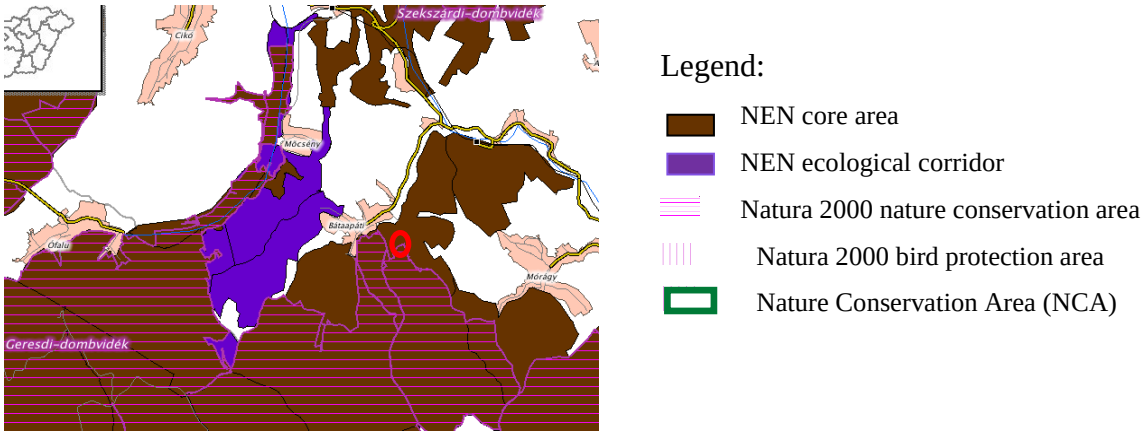


Figure 4-5 **The RHFT and its vicinity**

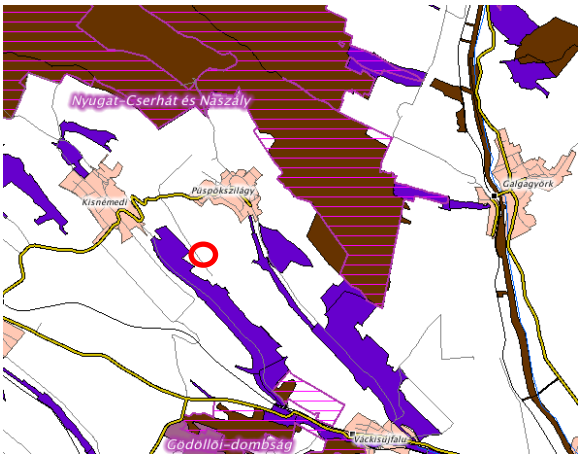
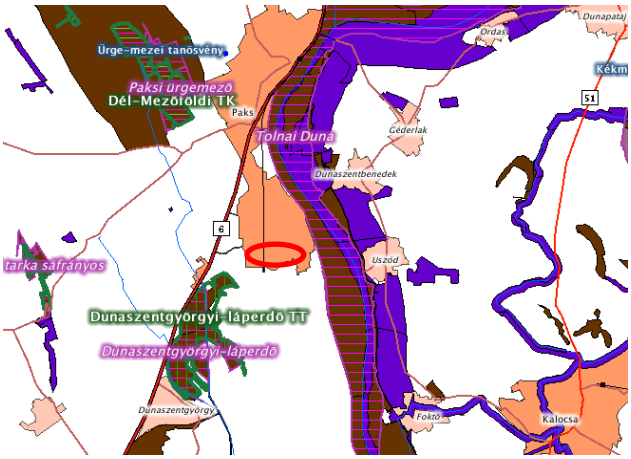


Figure 4-6 **The KKÁT and its vicinity**



– A protected biota would be affected in the case of the NRHT if the planned developments are accompanied by surface area use, but only subsurface expansions are expected here. (High-sedgy associations in Nagymórágy Valley were removed during the installation.) The surface site is part of the NEN core area, and is bordering the Geresd hillside Natura 2000 area;

– The ecological corridor element of the NEN is located west to the facility in Püspökszilágy (RHFT);
– The site of the KKÁT in Paks is situated near the Tolna Danube Natura 2000 area, and the Danube is an element of the NEN ecological corridor.

The surface site of the **National Radioactive Waste Repository** is located on the periphery of Bátaapáti, at the bottom of Nagymórágy Valley, however, the facility is situated mostly under the surface. The surface site is surrounded mainly by forests. The site is bordered by the Geresd hillside Natura 2000 nature conservation area, the code of which is: HUDD20012. The smallest northern extension of the nearly 6600 ha Natura area touches the site on its western side.

Forest communities are the most typical on the nature conservation area, and mainly Illyrian Fagus sylvatica forests (91L0), Pannonian-Balkanic turkey oak-sessile oak forests (91M0) and Illyrian beech forests (91K0) as well as alluvial meadows of river valleys are found here. (The green line on the Google aerial photo indicates the border of the Natura 2000 area.) Based on the previous studies, the small watercourses of the region are also characterised by a relatively rich association.

Marking animal species of the area:

– the fire-bellied toad occurring in wet habitats (*Bombina bombina*),
– the Hungarian Isophya costata (*Isophya costata*) preferring wet grasses and the large copper (*Lycaena dispar*),
– the precious protected species of oak forests are the stag beetle (*Lucanus cervus*), the scarce fritillary (*Euphydryas maturna)* and the great capricorn beetle *(Cerambyx cerdo*),
– the eastern eggar (*Eriogaster catax*) living on warm, semi-dry grasses,
– the barbastelle nesting in old trees (*Barbastella barbastellus*), the common bat living in buildings (*Myotis myotis*)
– the Rosalia longicorn (*Rosalia alpina*) preferring mainly beech forests.

The greater pasque flower (*Pulsatilla grandis*) flowering on slope steppes, forestry and dry grasslands.

The vicinity of the **Radioactive Waste Treatment and Disposal Facility of Püspökszilágy** is basically a cultivated landscape: mostly with large plough-lands, small grassy fields and several creeks with permanent water supply (Némedi and Szilágyi Creeks). The latter still preserve the elements of the former natural vegetation, but are largely affected by the human impact: the original aquatic plant (pondweed) zone is missing, and there are no significant fish communities either, while they offer a habitat to a diverse macro-invertebrate community.

The loess grass remnant spreading at the southwest corner of the site is an area offering a home to ecologically precious, protected species, and is an ecological corridor as part of the NEN.

The indigenous turkey oak-sessile oak forests originally typical of the neighbouring hills are not found any more in the direct vicinity of the site. The semi-natural communities occurring in the wider vicinity are mainly turkey oak-sessile oak forests, loess steppes, artificially regulated and deepened creeks as well as aquatic habitat mosaics accompanying the watercourses, shrunk and degraded to their fragments and rich in bird fauna.

The vicinity of the **Interim Spent Fuel Storage Facility** and the Paks Nuclear Power Plant is of a mosaic landscape structure, with mostly large plough-lands south of it, pastures, industrial areas, small plough-lands north of it, forests west of it, and mainly wet lands east of it. Agricultural lands as well as planted deciduous and pine forests dominate, and relatively large areas are covered by various water surfaces (the Danube, a fish pond, Kondor Lake, canals). Grassy spots on acidiferous arid sand are also typical of the vicinity of the power plant. Each landscape element is characterised by a significant anthropogenic impact. Continuous natural areas considered relatively large in comparison to the studied area as a whole are the Danube and its bank and the moorland forest of Dunaszentgyörgy.

In general, degradation of the area, presence of invasive plant species and growth of invasive species are typical.

4.1.2.5 Built and urban environment

The major population characteristics of the three settlements incorporating the three facilities are as follows:

Table 4-5 **Population, population density**

Settlement	Urban area (km^2)	Permanent population (inhabitants)	Population density (inhabitants/km^2)
Bátaapáti	20.44	442	22.1
Püspökszilágy	25.31	755	30.2
Paks	154.08	19.428	126.16

Bátaapáti is the smallest settlement as regards its area, its population and the population density. Paks is the largest town in terms of all the three characteristics. At the turn of the 19th and 20th centuries, the settlement was a district capital and a significant agricultural town. After World War II, its development stopped, and the set-back was reversed by the construction of the nuclear power plant. The population of Paks significantly increased in a short time, and it became mainly a single-function town.

The key urban environmental characteristics of the three settlements are summarised as follows:

– Urban environmental characteristics of **Bátaapáti**
  - *Demographic characteristics*: In 2013, the settlement had 442 inhabitants. The mortality and migration rates are lower than the rate of live births, and therefore a slight growth of the population has been observed in the recent years. The balance of vital statistics was 0.45% in 2013, which is more favourable than the district, county and national average rates. The age distribution is also favourable, 22.17% of the permanent population is under 18, and the rate of the elderly is only 16.51%.
  - *Infrastructure:* All inhabitants are connected to the electricity network and the drinking water network. The sewage of the settlement is collected by a regional sewer network. 36.32% of the accommodations are connected to the gas network. Communal waste collection service is used by the settlement.
  - *Available institutions:* There are no general medical practice activities and child-care centres in the settlement. A kindergarten and a primary school are locally available.
  - *Economic characteristics:* In 2013, the number of enterprises registered in the settlement was 39.
  - *Employment rate:* The registered number of job-seekers was 24 in Bátaapáti, which is 5.43% of the settlement's population. The job-seekers include 10 men and 14 women. Out of the 24 persons, there are 8 job-seekers beyond 180 days, and 6 job-seekers beyond one year. 4 of them are first-time job-seekers. The majority of the job-seekers (22) performed physical work during their previous employment.

  The urban environmental characteristics have substantially improved since the commencement of the research works and the establishment of the disposal facility at the settlement.

– Urban environmental characteristics of **Püspökszilágy**
  - *Demographic characteristics*: In 2013, the settlement had 755 inhabitants. The mortality and migration rates are higher than the rate of live births. Therefore a slight decrease of the population has been observed in the recent years. The balance of vital statistics was -1.32 % in 2013, which is more unfavourable than the district, county and national average rates. Only 19.73% of the permanent population is under 18, and the rate of the elderly is 24.37%, which is unfavourable.
  - *Infrastructure:* All inhabitants are connected to the electricity network and the drinking water network. 85.81% of the accommodations are connected to the gas network. Communal waste collection service is used by the settlement.

- *Available institutions:* There are no general medical practice activities and child-care centres in the settlement, but there is a kindergarten. A primary school is locally available in the settlement.
- *Economic characteristics:* In 2013, the number of enterprises registered in the settlement was 121.
- *Employment rate:* The registered number of job-seekers was 22 in Püspökszilágy, which is 2.91% of the settlement's population. The job-seekers include 7 men and 15 women. Out of the 22 persons, there are 8 job-seekers beyond 180 days, and 6 job-seekers beyond one year. 2 of them are first-time job-seekers. The majority of the job-seekers (17) performed physical work during their previous employment.

– Urban environmental characteristics of **Paks**

- *Demographic characteristics*: In 2013, the settlement had 19.428 inhabitants. The rates of mortality and migration are higher than the rate live births, and therefore a slight decrease of the population has been observed in the recent years. The balance of vital statistics was -0.62 % in 2013, which is more favourable than the county average rate but worse than the national average rate. Only 17.66 % of the permanent population is under 18, and the rate of the elderly is 21.95 %.
- *Infrastructure:* All inhabitants are connected to the electricity network and the drinking water network. The town has an independent wastewater treatment plant. 34.52% of the accommodations are connected to the gas network. The settlement uses waste collection services, Paks is the waste management centre of the region with an independent waste treatment plant.
- *Available institutions:* As regards the available institutions, it is in an excellent situation. There are 9 general medical practitioners and 5 paediatricians. As regards children's institutions, 1 child-care centre, 7 kindergartens and 6 schools operate. The settlements has also secondary education establishments (grammar, secondary and vocational schools), and the secondary school is connected to the power-plant with its energetic training. Due to the power plant, Paks is in a better situation than other towns of similar measures as regards the number of available institutions.
- *Economic characteristics:* In 2013, the number of enterprises registered in the settlement was 2 973.
- *Employment rate:* The registered number of job-seekers was 626 in Paks, which is 3.22% of the settlement's population. The job-seekers included 286 men and 340 women. Out of the 626 persons, there are 290 job-seekers beyond 180 days, and 152 job-seekers beyond one year. 118 of them are first-time job-seekers. The majority of the job-seekers (471) performed physical work during their previous employment.

Cultural-historical and archaeological values were found in all the three settlements, and potential impacts on them were assessed during the establishments. No conflict situations were caused by their existence.

A targeted study[39] of the health situations of the settlements was carried out in the vicinity of the two sites operating for a longer time, the Paks Nuclear Power Plant and the disposal facility of Püspökszilágy. On the basis of the statistical data processing, it was found that the number of cancer-related deaths was lower on the studied area in both cases than it was expected in accordance with the national conditions. The rate of malformations did not deviate from the expected rate.

[39] The studies were intended to assess the frequency of cancer-related diseases and malformations in the region in comparison to the national rates.

Noise

The current situation is summarised as follows:

- ***National Radioactive Waste Disposal Facility:*** Bátaapáti is a dead-end village not exposed to transient traffic. Agricultural and forestry machines considered periodic noise sources do not cause an assessable regular noise pollution. There are no operational noise sources, and only the sport grounds and the public catering units are notable as leisure-time noise sources.

  Noise measurements intended to assess the baseline situation were made in Bátaapáti (on the urban area of the settlement, at several points of the planned site), Szálka, Kismórágy and along the planned transport routes between 2002 and 2004 during the preparation of the disposal facility. Based on this, the permanent background noise is (L_{95}) 33-39 dBA[40]. On the basis of the results of the assessment, the use of the road near Kismórágy is recommended against the road of Szálka.

  The operational noise sources of the NRHT, the ventilation unit and the concrete plant (concrete pouring within a closed building) do not cause noise pollutions approaching the limit-value at the objects to be protected. The traffic-related noise pollution (several consignments per week from the nuclear power plant, 15-20 cars per day) is a negligible extra pollution.

- ***Radioactive Waste Treatment and Disposal Facility of Püspökszilágy:*** Püspökszilágy hosting the RHFTand Kisnémedi settlement also situated close to the site are within a quiet zone where urban noises, such as dog bark, human voice, and natural voices dominate. Thereby traffic, vehicles occasionally passing by become highly affecting factors.

  Periodic noise sources operating on the agricultural and forestry areas of the vicinity are machines which do not cause an assessable regular noise pollution. Neither operational, nor leisure-time noise sources are characteristic on the area. Settlements[41] belonging already to the agglomeration of the capital are situated south, south-west to Püspökszilágy, and the impact of traffic - and of the service provision and economic activities to a less extent - is obviously intensifying in this direction.

  The noise sources of the facility include the crane truck (operating on several occasions in a month), the safety related sources (detectors operating for several minutes in a month, and a diesel power generator used in the case of longer power failures), several machines (such as forklifts), building installations (air-conditioners, fans), and maintenance activities (workshop, lawn-mowing). According to the results of the in-situ measurements performed during the impact assessment[42] made in 2004-2005, the operational noise caused by the site is not detectable in the vicinity of the nearest dwelling houses (Püspökszilágy, Kisnémedi). (We are not aware of any significant change taken place since then.)

- ***Interim Spent Fuel Storage Facility:*** The facility situated at 5 km from the centre of the town of Paks is located in an agricultural region. No assessable regular noise pollution is caused by the periodic noise sources of this activity. Therefore the noise condition is determined by the service provision and economic activities and the traffic on the residential areas. Small settlements are typical of the vicinity of Paks.[43] Dunaszentbenedek situated at the other side of the Danube is the nearest residential area.

[40] For reference purposes, the maximum noise pollution caused by an animal or human voice is typically (L_{max}) 89-95 dBA.

[41] The nearest towns are Őrbottyán at ca. 7 km, Veresegyház at 9 km, but the more significant ones, Aszód and Vác are at ca. 15 km.

[42] Analysis of the environmental impacts of the Rhft. of Püspökszilágy – Closing Report (ETV-Erőterv Rt., 2005.)

[43] The nearest towns are Kalocsa (~ 10 km) situated between the Danube and Tisza, and Tolna (~ 20 km), and the county centre, Szekszárd at ca. 30 km.

According to measurements made in 2002[44], the operational noise emitting sources of the power plant (steam turbines, a transformer substation, and a transformer station, diesel generators, a cooling house, submersible pumps and fire water pumps, a high-pressure compressor, maintenance and milling shops, a cooling water weir) and traffic (the assemblies are transferred to the KKÁT by rail, for example) do not exceed the relevant limit-values in the case of facilities to be protected outside the area. There is no exceedance of the noise emission limit-value at the boundary of the site either. As regards the facilities to be protected within the site (offices, health centres, rest rooms), noise pollution reaching the limit-value was measured at one location due to the nitrogen plant providing nitrogen necessary for the interim disposal facility and noise pollution above the limit-value was measured at another location due to inner traffic.

Based on the noise measurements performed along the facades and the road networks to be protected in the impact zone of the planned power plant in connection with the preparation of the new block of the Paks Nuclear Power Plant in 2012, the base noise pollution is below the permissible noise pollution limit-values everywhere in the vicinity of the dwelling houses on the Danube bank. However, the traffic noise emissions of the busy roads passing by the residential areas are significant, the noise situation of the town is determined definitely by the traffic related noise pollutions.

Vibration

Vibration measurements area available for two facilities:

- ***National Radioactive Waste Disposal Facility:*** In-situ vibration measurements were made in 2005-2006, during the preparation of the facility, in order to forecast the impact of the shaft deepening made with explosions and of the transport. No exceedance of the vibration exposure limit-value was recorded in the baseline condition in Bátaapáti and its vicinity (Palatinca, Kismórágy), and the probability of occurrence of building structure damages caused by the traffic was found negligible. Within the vibration impacts capable of spreading over long distances[45], the vibration impact of the transport-related truck traffic necessary for the establishment raised concerns. It was found that vehicles with laden mass below 20 t do not cause exceedances of the vibration limit-value anywhere along the transport route. The environmental impact study recommended to avoid night-time transports.

  The impact zone of vibration exposure caused by maximum 1 or 2 trucks per day in connection with the operation of the NRHT is limited to access road no. 56103 leading to Bátaapáti hardly affected by truck traffic, i.e. to Rozsdásserpenyő situated by it and to some buildings of Bátaapáti situated by the access road.

- **Interim Spent Fuel Storage Facility**: Vibration exposure measurements were made also for the baseline situation in 2012 in connection with the preparation of the new block of the Paks Nuclear Power Plant mentioned in the noise chapter. During the measurements, the impacts of the already existing facilities (such as the KKÁT) could be also mapped. According to the results, vibration exposure increase was detectable from the vibration sources (the existing power plant and the auxiliary facilities as well as road and rail traffic) at all measuring points during the studied period. However, the vibration exposure related to the measurement/assessment period was lower than the vibration exposure limit-value in all the

[44] Source: Establishment of new nuclear power plant blocks - Preliminary consultation documentation (PYÖRY Erőterv Zrt. 2012)

[45] There was no facility to be protected within a 500-metre zone, and therefore only vibration levels capable of spreading for long distances were studied.

three orthogonal directions, and the highest vibration exposure value was lower than the vibration exposure threshold.

At the same time, there is no information available on the vibration exposure of the operation of the KKÁT, but on the basis of the above, it is assumed that this does not raise concerns either.

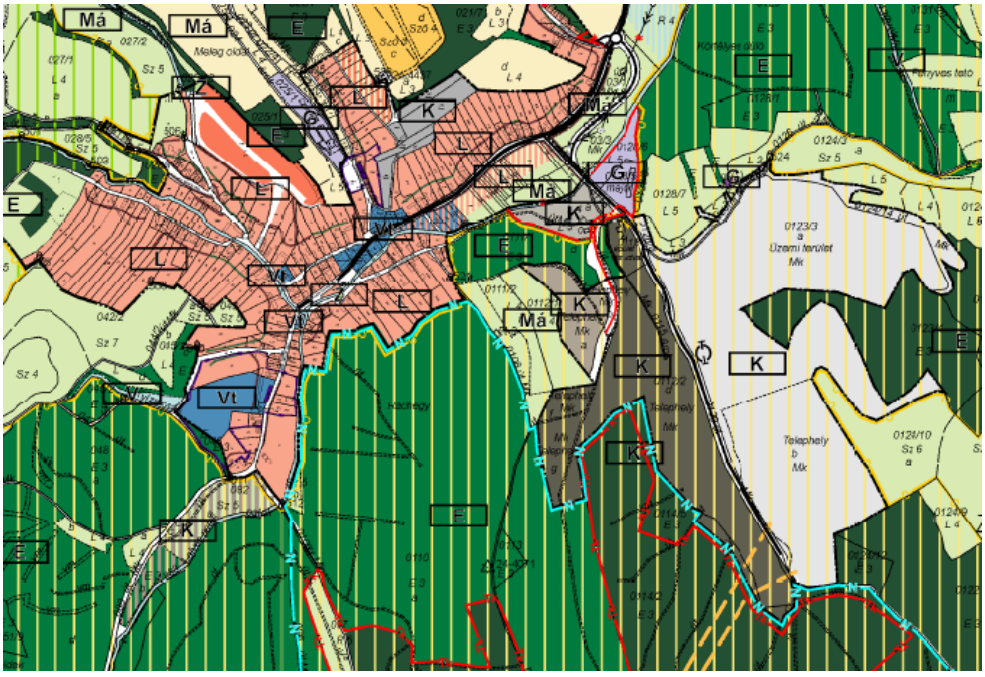
4.1.2.6 Landscape and territorial structure

The characteristics of the current territorial structure of the studied regions are briefly summarised on the basis of the county and local settlement plans. All of the three studied areas are affected by human interventions. It is the vicinity of the Paks Nuclear Power Plant that has been restructured to the greatest extent. It is the vicinity of the NRHT that is closest to the natural state where only the surface site is considered significantly affected, and the vicinity is almost intact.

In the modification of the settlement plan of Tolna County, both the NRHT and the KKÁT are mentioned as key elements of the county's economy.

– ***National Radioactive Waste Disposal Facility***: The land use of the structure of the vicinity of the site is clearly indicated on the structural sheet of the modification of the Settlement Plan of Bátaapáti approved by the Mayor's Office of the Local Government of Bátaapáti in its Decision 12/2010 of 9 March 2010. See ***Figure 4-7***. The site is defined as a special area on the regulatory sheet. The site of Bátaapáti is registered as a landscape conservation area of national importance.

Figure 4-7 **Settlement Plan of Bátaapáti structural sheet** (sector)



Legend section for the waste treatment related areas

VISITORS' CENTRE

DEPOSIT

LOW AND INTERMEDIATE LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY

AREA MARKED BY A BLUELINE NATURA 2000 AREA

YELLOW CROSS-HATCH NEN CORE AREA

– ***Radioactive Waste Treatment and Disposal Facility of Püspökszilágy:*** In accordance with Annex 2 to the modification of the Settlement Plan of Pest County (regional structural plan) approved by the Local Government in its Decision 5/2012 of 10 May 2012, the studied region is an agricultural and forestry region. See ***Figure 4-8***. It must be also noted that landscape conservation zone areas of national importance are situated both north-east and south-west to the site. See ***Figure 4-9***.

Figure 4-8 **Regional structural plan of the Settlement plan of Pest County** (sector)

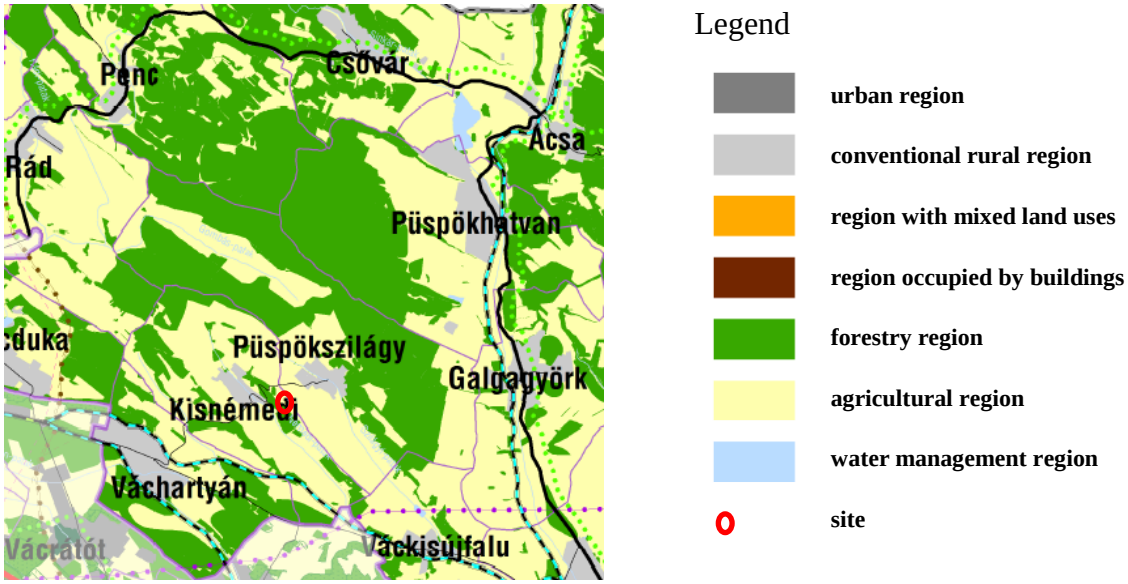


Figure 4-9 **Landscape conservation zone area of the Settlement plan of Pest County** (sector)

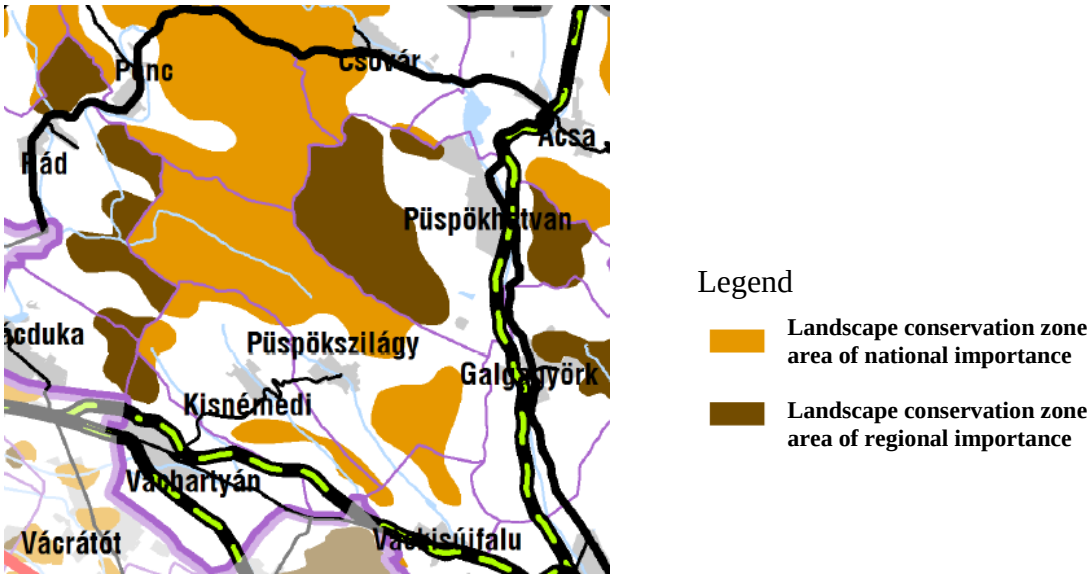


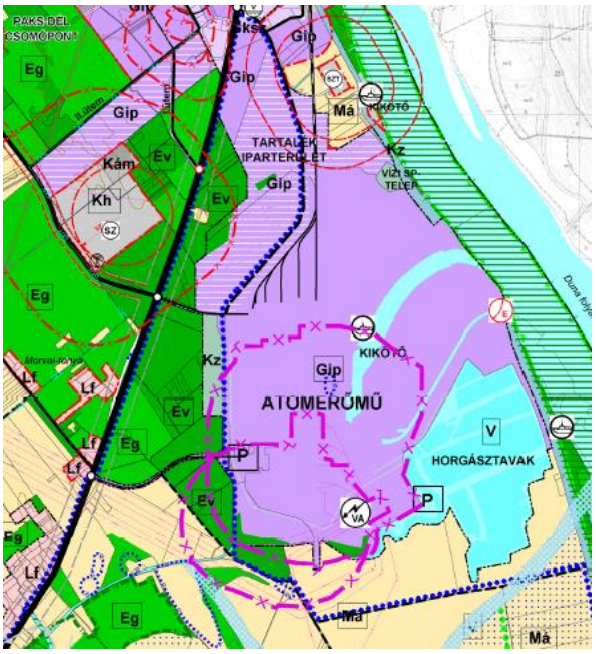
Figure 4-10**Settlement Structural Plan of Paks Town** (sector)

– ***Interim Spent Fuel Storage Facility:*** The whole area of the power plant, including also the KKÁT, is defined as an industrial and economic area in the Settlement Structural Plan of Paks

town[46]. ***Figure 4-10*** shows that though the site is uniformly marked, the 500 m protective zone of the two facilities, i.e. the nuclear power plant and the KKÁT are separately marked. (Purple boundary line broken with x marks.)

The settlement plan of Tolna County does not contain any parameter important for us.

The settlement plan of Baranya County states that the county is a potential depth site for high level radioactive waste.



4.2 The expected impact factors and impact processes of the activities planned in the National Programme

In the following chapter part, the impact factors and impact processes of the activities specified in the National Programme having direct and indirect, radiological and conventional environmental impacts are summarised, which will constitute a part of the environmental licensing procedure. The chapter part is intended to prepare the subsequent licensing procedure. **So the specification of the impact factors and drawing of the impact process figures will serve as aids in the subsequent planning phases.**

The environmental impact process figure well proved during the environmental impact studies was used by us to present the environmental consequences related to the activities contained in the Programme. In the first step, the impact factors[47] of the planned activities were identified.

The life cycle of the facilities intended for the treatment and final disposal of radioactive waste and spent fuel and covered by the National Programme is divided into more phases than usually (establishment, implementation, abandonment):

- research
- establishment (construction)
- implementation (operation of the disposal facility, waste delivery, safeguarded storage, retention)
- expansion
- backfilling, final shut-down, abandonment
- institutional control

The characteristic activity elements from which the changes of conditions of the environmental elements/systems initiate must be specified in the first step in view of these sections.

[46] Plan specified by the Municipal Council of Paks Town in its Decision no. 2/2003 Kt. of 12 February 2003, which is consolidated in Decision no. 79/2011 of 23 November 2011.

[47] The impact factors are independent steps or work phases of the activity from which the changes taking place in the individual environmental elements initiate.

4.2.1 Specification of the impact factors

The drawing of the impact process figure is based on the collection of the impact factors. It is worth distinguishing the impact factors causing temporary and permanent changes during the assessment of the environmental impacts. The temporary impacts cause short term and non-permanent changes, while the permanent impacts are decisive in the evaluation of the individual activities.

In this case we took also into consideration that the National Programme expects basically further operation of the existing facilities, and beyond this, the expansion of the KKÁT and the NRHT, and only the technological development of the RHFT are expected. The final disposal facility for high level waste (to be established only in the long term in accordance with the National Programme) and the new interim spent fuel storage facility necessary for the new blocks will be new facilities. In the following point b), these are combined with the operation/expansion of the existing one, since the impact factors and the impact processes do not substantially differ in the two cases, only the volume of the construction works on the new facility will be obviously significant. In this case, the following activity phases were considered decisive impact factors as regards the studied activities:

a) Final disposal of high level waste

- Research activity
- Construction and long term operation of an underground research laboratory
- Temporary and permanent land use
- Construction work, implementation of the facility, landscaping and grading, earthworks
- Subsurface mapping (drilling, explosions)
- Preparations and transports for the construction
- Rock excavation, transport, stone breaking
- Establishment of a barrow pit and disposal sites
- Expansion of infrastructural elements
- Generation of construction waste
- Transport of high level waste to the disposal facility
- Operation of the facility, i.e. final disposal of waste materials
- Social services (heating, water demand, rainfall, wastewater and waste generation and treatment, passenger transport)
- Existence of high level disposal facility - restriction of land use

b) Additional operation and expansion of the interim spent fuel storage facility, establishment of a new disposal facility

- Transfer of spent used assemblies from the nuclear power plant
- Operation of the facility, i.e. interim storage of spent fuel assemblies
- Existence of the facility (sight, land use)
- Social services (heating, water demand, rainfall, wastewater and waste generation and treatment, passenger transport)
- Land use during the construction of the new facility/expansion of the existing one
- Construction/expansion works

- Transport for the construction/expansion
- Generation of construction waste
- Transfer of spent fuel to the final disposal facility
- Abandonment of the interim spent fuel storage facility

c) Operation and expansion of the low and intermediate level radioactive waste disposal facilities (NRHT and RHFT)

- Transport of radioactive waste from the nuclear power plant and the institutions
- Operation of the facility, i.e. treatment and final disposal of radioactive waste in the disposal facility
- Social services (heating, water demand, rainfall, wastewater and waste generation and treatment, passenger transport)
- Existence of the facility (sight, land use)
- Land use during expansion
- Establishment of new disposal facilities
- Disposal or selling of the excavated rock

4.2.2 Impact processes of the studied activities

The potential impact processes of the studied activities are presented below in the form of an impact process figure well proved in practice. This serves as a basis for us to define any points of conflict and designate the environmental aspects of further planning in the knowledge of the environmental features of the facilities and the expected impact processes.

The potential impact processes are defined on the basis of the impact factors. All impact processes that can be imagined during the activity are taken into consideration. The impact process figure is drawn with a method used during impact studies:

- The first column represents the affected environmental element or system;
- The second column is for numbering;
- The impact factors of the planned activity are indicated in the third column (the impact factor in question appears always at the environmental element which is affected by it directly, without any mediation). One impact factor may simultaneously affect more than one environmental elements at a time, but in different ways. In such cases, it is indicated for all the affected environmental elements. (These include e.g. the construction works which affect the air, the water and the biota, or the land use which affect the soil and the biota.)
- The expected direct impacts are indicated in the fourth column, and the indirect impacts in the next columns. The arrows indicate the spreading of the impacts towards the final impact recipients. Spreading can take place through several phases, mostly with decreasing and rarely with intensifying efficiency. In general, the intensity of the impacts tends to mitigate during the spreading.
- In general, the ecosystem and/or human being are the final impact recipients. The latter is separately treated and highlighted in the final column of the figure, since the impacts affecting the environment, i.e. changes taking place in the conditions of the environmental elements/systems can be fundamentally interpreted and detected from the aspect of human being.

The impacts expected during the establishment of the final disposal facility of high level waste, and the expansion and the operation of the low and intermediate level radioactive waste disposal facility and the KKÁT are summarised in the following three ***figures (4-11 to 4-13)***. (The figures do not contain the environmental processes resulting from the abandonment, closure and active institutional control or the impacts of accidents and damage events. This is because their impact factors and impact processes are by their nature identical to those shown on the figure, only the intensity of the impacts change.)

Only the establishment of the final disposal facility of the high level waste is a new activity within the activities presented on the figures. Land use (the values of lands used by the facilities and the related infrastructure) is a decisive impact factor in the case of new activities. In this case, however, the rate of land use is defined by the territorial features, i.e. the fact if the receiving formation is suitable for the disposal of such waste materials. This may overwrite other aspects during the land use. Potential unfavourable impacts can be reduced by minimising the land use by the surface facility and by compensating them to the necessary extent.

The planned expansions and the new facility must be implemented so that their radiological impacts do not cause impacts other than neutral ones under normal operating circumstances. These are impacts the existence of which can be confirmed (e.g. detected with a very sensitive instrument), but the change of condition caused by them in any environmental element or system is so small that the changes in them cannot be detected. (In general, changes of conditions not detectable on the basis of the fluctuation of the background exposures belong here.)

Within the conventional environmental impacts, transport related ones may be significant, irrespective of the fact if materials are supplied for the construction or expansion, or fuel and waste are transported. Air pollution, nose pollution and vibration exposure caused by transports can be reduced by carefully selecting the delivery routes and limiting the traffic volume. The majority of conventional exposures can be well treated with technical devices.

Figure 4-11 **Potential impact processes of final disposal of high level waste**

Environmental element/system		Impact factor		Direct impact		Indirect impacts		Man and biota as final impact recipients
Air and climate conditions	1	Construction works (research lab, site, depth disposal facility, infrastructure)	→	Air quality deterioration in the vicinity of the site				Disturbance, health deterioration in the vicinity of the site and along the transport routes
	2	Social services (research, establishment of a disposal facility, operation)	→					
	3	Passenger traffic	→					
	4	Delivery necessary for construction,	→	Temporary air quality deterioration along the transport routes				
	5	Transport of spent fuel (nuclear power plant disposal facility)	→	Air quality deterioration along the transport routes				
	6	Existence of facility	→	Change of the climatic conditions in the vicinity of the site				
Surface and subsurface waters	7	Rock excavation (research lab, disposal facility)	→	Change of the surface and subsurface water flow patterns, change of quality				Limitation, change of uses
	8	Construction works	→					
	9	Existence and operation of research lab and facility	→	Change of the subsurface water flow patterns, change of quality				
	10	Social services: water intake, rainfall and wastewater treatment	→	Quantity and quality changes of surface and subsurface waters		Pollution of surface and subsurface waters		
Soil	11	Land use (surface facilities, infrastructure)	→	Quantity reduction				
	12	Subsurface space formation/rock excavation	→	Quantity change		Soil pollution		Limitation, change of land uses
	13	Construction works, generation of waste	→	Soil pollution, soil quality deterioration				
	14	Social services: communal waste generation and treatment	→			Erosion		
	15	Operation of facility, storage of spent fuel	→	Pollution of subsurface formation				
Biota, ecosystems	16	Land use	→	Destruction of individuals, population, change of life conditions		Change of life conditions		Migration, degradation, biodiversity decrease
Artificial elements - Urban environment	17	Operation of facility, storage of spent fuel	→	Creation of new function		Satisfaction of economic need		Risk reduction, solution of waste treatment
	18	Construction works, subsurface space creation	→	Temporary noise and vibration level changes near the workplaces and the transport roads		Deterioration of condition near the site and transport roads		Unpleasantness, disturbance near the site and along the transport routes
	19	Transport for the construction						
	20	Existence of facility	→	Temporary noise level change along the transport routes				
Landscape	21	Existence of facility	→	Land use limitation				Landscape potential change

Figure 4-12 **Impact processes of the treatment of low and intermediate level radioactive waste and of the expansion of the disposal facility**

Environmental element/system		Impact factor		Direct impact		Indirect impacts		Man and biota as final impact recipients
Air and climate conditions	1	Social services (heating, hot water supply for service facilities, passenger traffic)	→	Air quality deterioration in the vicinity of the site				Disturbance, health deterioration near the expansion area and the transport routes
	2	Waste transport (nuclear power plant disposal facility)	→	Air quality deterioration along transport routes				
	3	Transport necessary for expansion, disposal (excavated rock, construction materials)	→	Temporary air quality deterioration at the disposal site and along the transport routes				
Surface and subsurface waters	5	Operation of the facility, waste treatment, disposal	→	Quality change of subsurface waters				Limitation, change of uses
	6	Social services: water intake, rainfall and wastewater treatment	→	Quantity and quality changes of surface and subsurface waters		Surface and subsurface water pollution		
	7	Expansion: rock excavation	→	Change of flow and run-off patterns				
Soil	8	Operation of the facility, waste treatment, disposal	→	Soil pollution, soil quality deterioration		Soil pollution		Limitation, change of land uses
	9	Social services: communal waste generation and treatment	→			Erosion		
	10	Expansion: rock excavation and disposal	→					
	11	Generation of construction waste	→					
Biota, ecosystems		No direct impact (the expansion entails subsurface land use)				Change of life conditions		Migration, degradation, biodiversity decrease
Artificial elements - Urban environment	12	Operation of the facility, waste treatment, disposal	→	Maintenance of existing function		Satisfaction of economic need		Risk reduction, solution ot waste treatment
	12	Expansion: rock excavation and disposal	→	Change of temporary noise level in the vicinity of workplaces		Condition deterioration		Unpleasantness, disturbance near the site and along the transport routes
	13	Existence of facility	→	Temporary noise level change at the site and along the transport routes				
Landscape	14	Existence of facility	→	Land use limitation				Landscape potential change

Figure 4-13**Additional operation and expansion of Interim Spent Fuel Storage Facility**

Environmental element/system		Impact factor		Direct impact		Indirect impacts		Man and biota as final impact recipients
Air and climate conditions	1	Social services (heating, hot-cold water supply, passenger traffic)	→	Air quality deterioration in the vicinity of the site				Disturbance, health deterioration near the expansion area and the transport routes
	2	Transfer of spent fuel (incoming and outgoing transport for final disposal)						
	3	Expansion and the necessary transport	→	Temporary air quality deterioration at the site and along the transport routes				
	4	Existence and expansion of facility	→	Change of the climatic conditions in the vicinity of the site				
Surface and subsurface water	5	Social services: water intake, rainfall and wastewater treatment	→	Quantity and quality changes of surface and subsurface waters		Surface and subsurface water pollution		Limitation, change of uses
	6	Expansion	→	Change of flow and run-off patterns				
Soil	7	Land use (within the industrial zone)	→	Quantity reduction				
	8	Operation of facility	→	Soil pollution, soil quality deterioration				Limitation, change of land uses
	9	Social services: communal waste generation and treatment	→					
	10	Expansion works	→					
	11	Generation of construction waste	→					
Biota, ecosystems		There is no direct impact (expansion is made within an industrial zone)				Change of life conditions		Migration, degradation, biodiversity decrease
Artificial elements - Urban environment	12	Operation and expansion of facility	→	Maintenance of existing function		Satisfaction of economic need		Reduction of risk, solution to disposal of spent fuel
	12	Expansion works and the necessary transport	→	Temporary noise level change near the workplaces and the transport routes				Unpleasantness, disturbance near the site and along the transport routes
	13	Existence of facility (operation, incoming and outgoing transport)	→	Noise level change near the site, the transport routes and the railway				
Landscape	14	Existence of facility	→	Land use limitation				Landscape potential change

4.3 Environmental impacts expected if the National Programme is implemented

Only the operation, expansion and technological development of the existing plants are expected until the first review of the National Programme due after 5 years, beyond the research and control tasks which do not have direct environmental impacts. Therefore the environmental impacts are mostly the same as the environmental impacts of the existing facilities, and will be temporarily changed only by the impacts of the expansion exerted in connection with the construction and transports. So the impact assessment were based on the impact estimates given in the environmental licences of the operating plants and on the current environmental impacts.

4.3.1 Radiological impacts

4.3.1.1 National Radioactive Waste Disposal Facility

According to the radiological risk analysis given in the safety evaluation[48] made on the NRHT in 2014 and serving as a basis for the modification of the licence for establishment, no radiation exposure higher than the specified official limit-value may affect the operating staff or the inhabitants of Bátaapáti considered a critical population group either during the normal operation of the facility or any possible malfunctions.

During the operational radiation protection calculations, the dose fields developing around the waste types received by the facility (200 l barrel, compact waste packages, waste packages containing cemented ion exchange resin) were defined, and the radiation exposures entailed by the whole disposal cycle of these waste types - lasting from the receipt of the waste to its final disposal - were analysed. The effective dose entailed by the volume to be disposed in one year and affecting the operating staff was defined for each waste type. During the analysis, no reasons hindering the use of the planned waste treatment and waste disposal technologies were explored. The effective radiation exposure of the members of the operating staff remained within the 20 mSv dose limit permitted in the Local Rules of Occupational Radiation Protection (LRORP) of the facility in each case.

The RHK Kft. delivers the waste from the Paks Nuclear Power Plant to the waste disposal facility by road, by trucks designed in accordance with the requirements related to the transport of radioactive waste and licensed for operation. The number of waste packages to be delivered varies depending on the their dose rates since supplementary protection may be necessary in order to meet the requirements of the European Agreement regarding the International Carriage of Dangerous Goods (hereinafter referred to as the ADR) during the transport of units with high dose rates. In accordance with the ADR, the radiation level in the transported consignment parts may not exceed the following values in the case of consignments containing radioactive materials belonging to groups LSA-I, LSA-II, LSA-III related to the unlimited activity content if the terms of delivery are met in the case of exclusive use.

- 10 mSv/h on any point of the external surface of the consignment parts or the overpacks,
- 2 mSv/h on any point of the external surface of the vehicle,
- 0.1 mSv/h, 2 metres from the vehicle.

[48] Source: Safety report serving as a basis for the modification of the licence for establishment (Modification of the disposal concept), RHK-K-029/14, May 2014

Radiation protection of the transporting staff is a primary task from a radiation protection aspect. Proper radiation protection can be provided for the driver by means of shielding at the cab side of the superstructure.

The so-called design emission levels expected during normal operation of the facility as well as the radiation exposure entailed by these emissions and affecting the critical population group were specified in the safety evaluation of the NRHT. The annual effective dose caused by the design atmospheric emissions is below 1 μSv/year for both age groups of the critical population group covered by the study (children between 1 and 2 years and adults), while the effective dose caused by the design liquid emissions is below 10μSv/year, which is substantially lower than the 100 μS/year dose limit-value specified by the licensing authority in the facility's license for operation in relation to the population.

An analysis was made in the licensing documentation on the basis of the conservative assumptions related to the radiological consequences of the incident scenarios conceivable in the case of the individual waste types for both the operating staff and the critical population group. In accordance with the results, the effective dose affecting the operating staff does not reach 1 mSv even in the case of the most unfavourable scenario (which is essentially lower than the 20 mSv effective dose limit-value per year specified in Government Decree 487/2015 of 30 December 2015 on protection against ionisation radiation and the relevant licensing, reporting and control system in relation to the occupational radiation exposure), while the radiation exposure of the critical population group is below the 100 μSv/year dose limit-value.

The long-term radiological calculations were based on a careful scenario derivation process complying with the international practice which was based on the analysis of the characteristics of the disposal system, the features, events and processes (FEP). These scenarios were studied also from the aspect of the safety functions of the disposal system on the basis of which a long-term safety model concept could be drawn.

In accordance with the long-term safety evaluation of the specified development history scenarios, the low and intermediate level waste deriving from the 50-year operation of the Paks Nuclear Power Plant can be safely disposed in the NRHT. The effective dose calculated for the adults and children in the reference group does not exceed the 100 μSv/year dose limit-value in the case of either the normal scenario describing the most probable behaviour of the system or the studied alternative scenarios.

4.3.1.2 Radioactive Waste Treatment and Disposal Facility of Püspökszilágy

The radioactive waste is transported from the place of waste generation usually by a closed truck owned by the RHFT and designed for this purpose and licensed for operation in accordance with the ADR requirements.

The general environmental review of the RHFT was performed in 2010, and the competent authority issued an environmental licence for operation to the facility in June 2011. The general review of the design emissions of the RHFT was performed in 2014-2015.[49] During the performance of the task, the functions of the individual facilities of the site and the relevant operations were reviewed from the aspect of radioactive emissions. The normal operational radioactive emission points and routes were detailed, an estimate was issued for the source intensities determining the emissions in view of the waste treatment/disposal technologies used at the site and the waste retrieval processes of the safety increasing measures, and the operational liquid and atmospheric annual radioactive emissions of the site were reviewed on the basis of them. The effective dose deriving from the reviewed gaseous and liquid design

[49] Source: The general review of the design emissions of the RHFT of Püspökszilágy, RHK–I–012A/14, January 2015

emissions and affecting the reference group of the population was estimated by means of dose conversion factors obtained during the review of the emission limit-values of the facility[50].

The gaseous emissions under normal operation resulted in an effective dose significantly lower than the dose limit-value (100 μSv/year) (by minimum 3-4 orders of magnitude), and the same applies to the effective doses deriving from all the liquid emissions introduced into the water environment and the municipal sewer, where the secondary dose of ^{137}Cs is by almost 2 orders of magnitude lower than the dose constraint value.

The operational safety report[51] supporting the continued operation of the interim disposal facility of the RHFT details the analysis based on the conservative assumptions related to the radiological consequences of the conceivable incident scenarios in relation to both the operating staff and the critical population group.

Assumed fire in the interim disposal facility on the basement level of the technological building entails the most severe dose consequences within the incident situations. The analyses using conservative assumptions have shown that the effective dose exposure affecting the staff present during the detection and extinction of fire is 1 mSv, i.e. significantly lower than the 20 mSv dose limit permitted in the Local Rules of Occupational Radiation Protection (LRORP) of the facility.

During the evaluation of the dose exposure affecting the population as a result of the fire, the analysts assumed several types of radiation routes. Radiation exposure may be caused mostly by the consumption of foods produced in the region and polluted by radioactive isotopes, while external radiation exposure deriving from radioactive isotopes settling on the surface after emission is the second most significant component. The dose via inhalation of the air polluted during the period of emission is by ca. 3 orders of magnitude less than the total dose. The total effective dose is below the reference level (100 mSv) related to the emergency radiation situation which is given in Section 9 of Government Decree 487/2015 of 30 December 2015 on protection against ionisation radiation and the relevant licensing, reporting and control system.

No comprehensive safety evaluation was made for the RHFT during either the commissioning or the licensing of the partial capacity increase implemented at the end of the 1980s, and none of the licence documents specified any waste receipt requirements or other limits for the types and volumes of waste to be disposed. Therefore, the RHK Kft. initiated to make a general safety evaluation in 1999. According to the analyses, the long-term safety of the facility is doubted in the period following the institutional control since the consequence analysis of the scenario covering an unintended human intrusion showed that significant doses (~100 mSv/year) may affect inhabitants exposed to radiation. These studies highlighted that correctional steps are necessary to improve the long-term safety of the facility, among others, by fully or partially removing high-activity closed radiation sources with high half-life values[50].

Based on the safety analysis, measures necessary for the long-term safety of the facility were specified. In 2002, the minister supervising the Nuclear Financial Fund approved document titled "The Safety Improvement Programme of the RHFT of Püspökszilágy - 2002-2005," based on which the first phase of the safety improvement programme was implemented. In 2005, after the first phase of the safety improvement programme, document "The Safety Improvement Programme of the RHFT of Püspökszilágy, Stage II (2006-2010)" was completed, which specifies the additional reconstruction tasks of the site. The major task in the first phase of the programme (phase 1, Stage II) was to discharge the four cells for

[50] Source: The general review of the emission limit-values of the RHFT of Püspökszilágy, RHK-I-013/14, December 2014

[51] Source: The operational safety report supporting the continued operation of the interim disposal facility of the RHFT (ÜMBJ), RHK–I–001/14, March 2014

demonstration purposes and to sort the discharged waste materials. The demonstration programme implemented with the retrieval, treatment, qualification and re-disposal of the waste materials of the four vaults (phase 1, stage II) was successfully closed in 2010, including part of the preparatory activities necessary for the continuation of the programme (summary analysis of the vault exploratory works, safety analysis supporting additional works, acquisition of an official licence for the continuation of the programme). Proposal "Results Already Achieved in the Safety Improvement Programme of the RHFT of Püspökszilágy and Additional Tasks, 2012-2017" has been completed, which serves as a basis for the additional works.

The results of the long-term safety evaluation[52] supporting the continuation of the safety improvement programme of the RHFT show that the effective dose affecting the critical population group is by orders of magnitude lower than the dose constraint in relation to the normal scenario, and is by one order of magnitude lower if compared to the results of the previous safety evaluation. During the study of the unintended human intrusion and road construction scenarios, the partial waste retrieval causes significant dose reduction (by ca. one and half order of magnitude) in comparison to the original waste inventory, while the doses can be further reduced (4 orders of magnitude in comparison to the original condition) as a result of full waste retrieval.

4.3.1.3 Interim Spent Fuel Storage Facility (KKÁT)

The spent fuel of the Paks Nuclear Power Plant is transported by TW-C30 railway cars in C30 transport containers filled with water to the neighbouring KKÁT (located within 1 km).

The environmental recipient of the gaseous radioactive emissions is the atmosphere under normal operation of the KKÁT. Radioactive liquid waste is transferred to the Paks Nuclear Power Plant where the treatment and control of radioactivity is performed. Liquid radioactive emissions directly from the KKÁT must not be introduced and disposed into the Danube river nor into subsurface waters.

In accordance with the requirements of the operational licence, the KKÁT must be operated in compliance with the emission limit-values and the emission limit-value criterion. The emission limit-values were derived from 10 μSv/year dose constraint in relation to the KKÁT. The emission limit-value criterion is as follows:

$$\sum_{ij} \frac{R_{ij}}{EL_{ij}} \leq 1,$$

where:

EL_{ij}= the emission limit-value of radioactive isotope i for emission method j (gaseous or liquid) [Bq/year];

R_{ij}= the annual emission of radioactive isotope i for emission method j (gaseous or liquid) [Bq/year];

The extra radiation exposure of the critical population group calculated from the KKÁT emission limit-value criterion is some nSv/year on the basis of data given in annual reports related to the operation and safety of the KKÁT, which does not reach one thousandth of the permissible dose restriction value.[53][7]

Based on the design data, the radiation exposure of 2.75 μSv/year deriving from the direct and diffuse gamma radiation of the KKÁT and affecting the critical population group (1300 m) is

[52] Source: Long-term safety evaluation supporting the continuation of the safety improvement programme of the RHFT, CNBGA00001D000, July 2010

[53] Source: Annual reports related to the operation and safety of the KKÁT, RHK Kft.

an extremely low value, by 3 orders of magnitude lower than the radiation exposure of ca. 2.5 mSv/year deriving from the natural background radiation and affecting all inhabitants.[54]

Probability based safety analyses were made to assess the radiological impacts of abnormal operation of the KKÁT. The study of abnormal events was divided into two groups: the so-called incidents belong to the first group. A detailed consequence study was made to define the incident dose values. Incidents exceeding the so-called design base, i.e. accidents belong to the second group, which are events with so low probability (a frequency $\leq 10^{-7}$ 1/year in accordance with the Technical Plan of the KKÁT) that they can be excluded from the design base of the facility due to the low occurrence frequency. Based on this, no detailed consequence study was made for them.

The following values recommended in the official opinion of 16 May 1994 of the Office of the Chief Medical Officer of the National Public Health and Medical Officer Service (OCMC of NPHMOS) were used for the emergency determination of the environmental radiological zone of the KKÁT

Condition change	**Radiation exposure levels (E), (μSv)**
neutral	E < 50
tolerable	50 < E < 500
exposing	500 < E < 5000
damaging	E > 5000

In the case of the majority of the incidents belonging to the design base, the secondary doses of the incidents belong to the lowest secondary dose class. Their secondary dose does not exceed 0.1 mSv, i.e. it remains in the lower range of the tolerable impact. There are only a few event chains the secondary dose of which is between 0.1 and 5 mSv. In general, their frequency is 10^{-6}/year, which is close to the screening criterion (10^{-7}/year) of extraordinarily rare events belonging to the design base of the facility. The condition change does not reach the damaging effect pursuant to the above qualification at the fence situated at a 100 m distance even in the case of an event with the highest secondary dose, and the impact will belong to the tolerable category within 3000 m.

There is only one event chain - failure of the filter of the active ventilation system on the emission route - the secondary dose of which is 48 mSv, and its annual occurrence frequency is 2.59E-07. While in accordance with Section 6.2.8.1400/a of the effective Nuclear Safety Regulations (Volume 6 of NSR) on the interim disposal of spent nuclear fuel, it is possible to screen from the initial events included in the design base those internal events that are caused by the failure of systems and system elements or by a human error, and the frequency of which is lower than 10^{-6}/year. The 10^{-7}/year screening criterion used in the analyses of the KKÁT is sufficiently conservative to screen the above events with a frequency less than 10^{-6}/year during the qualification of the impacts[45].

4.3.1.4 New Interim Spent Fuel Storage Facility

The interim storage of the spent fuel of the new nuclear power plant blocks can be implemented in the new national and foreign disposal facilities licensed for the receipt of the spent fuel in accordance with the National Programme. The terms of interim storage in Hungary are met for

[54] Source: Performance evaluation of the renewal of the operational licence of the KKÁT, NPA85O01E0100O, October 2014

the VVER-400 units at Paks while there will be appropriate location and possibility to construct the interim storage facility at the site of the new units. The environmental impact study of the new blocks studies the environmental impacts of the site together with the construction of the new interim storage facility. The spent fuel of the current units is stored in a Modular Vault Dry Storage-type interim storage facility. Concerning the new units, dry storage in containers is indicated as reference scenario within the potential interim storage possibilities in the environmental impact study. The spent fuel is stored in containers suitable for dry storage and provided with biological protection. The external surface of the containers is decontaminated, dried and controlled for surface pollution. After tightness tests, the containers are transported from the reactor's building to the interim spent fuel storage facility. The containers are expected to spend several decades on the storage area, and then the fuel elements will be transported either to the reprocessing facility or to the final disposal facility. There is the possibility to select a storage solution that does not need any additional manipulation since the surface containers provide proper protection also during the transports. The decisions on the storage solutions shall be taken at a later stage upon complex analysis performed previously. The environmental radiation exposure of the containers placed on the surface storage area does not exceed the dose constraint even at the border of the impact zone which is the same as the border of the safety zone.[55]

4.3.1.5 Final disposal of high level and long-lasting waste

Directive 2011/70/EUROATOM states that according to the position currently accepted in a wide circle from a technical aspect, the deep geological disposal as an end point of the treatment of high level waste and spent fuel considered waste is the safest and most sustainable solution at the moment.

There has been no final decision made in Hungary for the back-end of the nuclear fuel cycle in relation to the energy reactors. The selection of the location of a depth geological disposal facility is in process in addition to the interim storage of spent fuel. This disposal facility will be necessary in the case of the introduction of any fuel cycle back-end method. Therefore Hungary is committed to dispose the high level and long lasting radioactive waste in a stable, depth geological disposal facility within the area of the country.

After the performance of a nation-wide formation qualification research (screening) in 2000, a research programme was commissioned by the RHK Kft. to designate the locations of the site suitable for the disposal of high level and long lasting radioactive waste and of a new underground research laboratory in West Mecsek recommended for further research on the basis of the results of the national screening.

In 2012, the RHK Kft. made a research plan for stage 2 of surface phase I which was approved by the relevant authority in May 2013. The research relaunched in 2014 is the continuation and completion of stage 1 interrupted in 2006. The purpose of the research is to make a general qualification of the site, to acquire geological data and information necessary for the safety evaluation, and to reduce uncertainties. The target area can be limited and the detailed plan of the next research phase can be made on the basis of the integrated evaluation planned by the end of the research phase.

The establishment and operation of the depth geological disposal facility and, prior to that, of the subsurface research laboratory are activities subject to an environmental impact study. The commission evaluations serving as a basis for the planning process and the multi-step licensing procedure as well as the in-situ research activities displayed for several decades make sure that

[55] Establishment of new nuclear power plant blocks at the site of Paks, Environmental impact study, Treatment and disposal of radioactive waste and spent fuel, MVM Paks II. Zrt.

the disposal facility can be implemented, operated and closed so that the radiological impacts affecting the environment in the individual life cycles of the facility (operating staff, inhabitants, biosphere) remain below the limits specified in the effective legislation and official requirements.

4.3.2 Conventional environmental impacts

4.3.2.1. Air climate

Air quality

Air polluting materials will be emitted basically in connection with the operation (and later abandonment) of the individual existing disposal facilities (local air pollutants and transport) on the one hand and during the necessary expansions and the implementation of the new facilities on the other hand. In this chapter, the greenhouse gas emissions closely related to the climate change are also discussed.

– ***National Radioactive Waste Disposal Facility:*** The operational air polluting sources related to the operation of the disposal facility are not significant from the aspect of emissions, as it was stated in the case of the basic condition. (See boilers, ventilation system, concrete plant, several machines.) The same applies to the necessary freight and passenger traffic.

  The abandonment of the blocks of the nuclear power plant significantly increases the waste volume to be supplied. The major part of the waste materials deriving from abandonment will be low and intermediate level waste materials. In the case of the first four blocks, it will be 27 000 m^3 (very low level waste materials: 80%), and in the case of each new block it will be 18 300 m^3 (very low level waste materials: ~89%). The volume of the very low level waste is highlighted as by introducing this waste category, the volume to be transported to Bátaapáti may substantially reduce depending on where they are disposed. The potential unfavourable impacts of the transport may be mitigated with scheduled transports. Due to the long-lasting abandonment process (e.g. 10-15 years in the case of new blocks), it will be obviously achieved. (The new blocks will be abandoned in the distant future so the method and process of the effective implementation and the rate of emissions are extremely malleable.)

  The additional expansion of the facility - naturally involving the emissions of air pollutants - is planned to be adjusted to the transport schedule of the nuclear power plant waste, the driving-out of the new storage chambers and then the construction of reinforced concrete vaults in the chambers are, in fact, continuously in process.

  In addition to the operation of the machines, the abandonment, i.e. the backfilling of the system of cuts will entail also intensive transports, which may cause air pollution reaching even the level experienced during the establishment.

– ***Radioactive Waste Treatment and Disposal Facility of Püspökszilágy:*** There are no air polluting sources emitting conventional air pollutants and subject to announcement at the site, and only a limited number of machines (e.g. forklifts) operate.

  The currently supplied volume is small; ca. 10–15 m^3 of radioactive waste and 400-500 used closed radiation sources are received from the institutions. In the Research Reactor, ~2 m^3 of solid radioactive waste, and ca. 100 litres of radioactive ion exchange resin are generated, and several m^3 of sludge accumulates at the bottom of the liquid waste collecting containers by the end of the operating period. The Training Reactor supplies 3-8 kg sackful of solid and a few litres of liquid radioactive waste on 6 occasions in a year. The above result in the arrival of maximum 1 or 2 vans. The passenger traffic is also insignificant, and is only ~15-20 cars per day, including also the visitors. This traffic entails a negligible emission in relation to the direct vicinity, and is even lower along the delivery routes.

So there is no essential air pollutant emission either during the activities performed at the site or in connection with the necessary delivery. In addition, the fact that the ventilation of the area is good due to the relief and the system of valleys running in north-western and south-eastern directions is also favourable.

In the framework of the development of the RHFT, a hall of light structure equipped with a crane is planned to be constructed by 2017, and its construction will obviously entail air pollutant emissions, however, the impact is expected to be insignificant.

Delivery of higher volumes of waste to be treated is expected during the abandonment of the Research and Training Reactors. The expected volume of the low and intermediate level waste in 2027[56] is 50 m^3 (Training Reactor), and in 2033 is 260 m^3 (Research Reactor). In the case of the supply routes, this entails a higher but still tolerable emission, an immission estimated to stay within the limit-value, and therefore scheduled supply is recommended.

Waste materials that will not be finally disposed on the area of the RHFT will be retrieved and delivered out by the end of the lifetime of the disposal facility, the second half of the century, and this will entail an extra emission in comparison to the current emissions, but the unfavourable impact can be mitigated with scheduled transports. In addition, the final vault covering will constitute a part of the closure.

- ***Interim Spent Fuel Storage Facility:*** The spent fuel of the Paks Nuclear Power Plant is delivered to the KKÁT located within 1 km. The annually delivered volume per block is 100 pieces of spent fuel assembly each with a weight of 215 kg, which are delivered in transport containers each containing 30 pieces, which means ca. 13 transport containers per block and per year. Already due to the low frequency, the transport does not entail notable air pollutant emissions. The emissions of the operation of the facility (drying, operation of the transfer machine and the ventilation systems) are also insignificant.

  The interim storage facility continuously operated and operates simultaneously with the expansion. Air pollutant emissions are expected during the expansion along the transport routes and at the site, but its rate is not significant.

  The interim storage of the spent fuel of the new nuclear power plant blocks is expected to be necessary from 2031-2036. No decision has been made on the disposal: it may be implemented in a new national or foreign disposal facility licensed for the receipt of spent fuel. Terms for interim storage will be provided at the site of the nuclear power plant in Hungary. Due to the transport demands (and therefore, among others, the resulting air pollutant emission), national interim storage is more favourable, particularly if the final disposal must take place in a national disposal facility. Obviously, air pollutant emissions are expected also during the construction of the interim storage facility, however, local interim storage is still more favourable as a whole.

  The waste materials stored in the interim storage facility (facilities) must be transported directly to the final disposal facility if they are not reprocessed. And the interim storage facility (facilities) must be abandoned by transferring the generated waste to a disposal facility suitable for the type of waste. The abandonment and the transport will entail air pollution emissions at a rate similar to the impacts of the establishment. The unfavourable impacts of the transport can be mitigated with scheduled transports in this case again. In the case of a long-lasting abandonment process, it will be obviously achieved.
- ***Final disposal facility of high level waste:*** The preparation of the depth geological disposal facility (exploration, drilling, explosion) and its implementation (particularly rock excavation, transport) in the distant future may entail significant air pollutant emissions.

[56] These are reference dates given in the Programme, which may change subsequently.

During the operation, partly the supply and partly the activities displayed on the site (machines, ventilation, heating etc.) entail air pollutant emissions.

High level waste and spent fuel (in a form depending on the fuel back-end cycle) are to be transported to the facility. In the currently operating blocks, high level radioactive waste generated yearly is 5 m^3. The expected volume of high level waste is only 73 m^3 even during the abandonment of the currently operating 4 blocks, and the future abandonment of the new blocks will entail only 85 m^3 high level radioactive waste according to the estimates. Contrary to the low level waste continuously generated in small volumes during the operation, transports will be more concentrated and involve large volumes during the transfer of the spent fuel and the abandonment. The long-lasting abandonment and the scheduled transports will mitigate the pollutions deriving from transports.

The establishment and operation of the depth geological disposal facility and, prior to that, of the subsurface research laboratory are activities subject to an environmental impact study. During this, the emissions can be assessed and evaluated in the knowledge of the location and other parameters. During the selection of the site of the disposal facility, safe disposal must be the primary aspect, and the selection of the location is influenced not by the transport distances.

Connection of the National Programme with the climate change

As regards the climate change, several issues may be examined; including partly the rate of greenhouse gas (GHG) emissions affecting the rate and extent of additional significant climate changes, and partly the ability to reduce the negative effects already taken place, and the vulnerability against climate change, accommodation to the changes. As regards the treatment of the spent fuel and the radioactive waste, basically the GHG emission and the vulnerability to the climate change should be evaluated within the above.

The **expansion** of the facilities (NRHT, KKÁT) and the **implementation** of the new KKÁT, a final disposal facility for high level waste as well as the **operation** - via the fuel use of the machines, energy consuming equipment and transport vehicles - will unavoidably **entail the emission of greenhouse gases** (mainly carbon dioxide and N_2O in the case of vehicles with catalytic converters). Their extent can be changed, in fact, only by minimising the transports (e.g. interim storage of the spent fuel related to the new nuclear power plant blocks in Hungary), and perhaps by replacing road transport with another method of transport (delivery to the KKÁT is made by rail).

The highest possible rate of use of secondary raw materials may have a favourable effect in the case of new facilities (new KKÁT, final disposal facility of high level waste). This will contribute not only to more sustainable management of natural resources but also to the reduction of the GHG emissions (e.g. pavements during road constructions).

However, the highest rate of GHG emission savings could be achieved by reprocessing the spent fuel. The nuclear power plants are considered GHG free energy sources, while in view of the whole life cycle (which include, among others, uranium mining, enrichment and transport as well as the treatment of the waste materials of the technology), nuclear energy is among technologies causing the lowest GHG emissions (less than 15 grams of CO_2 equivalent / kWh)[57]. Therefore and also for the purpose of reasonable management of the natural resources, **changeover from the current open fuel cycle to a closed cycle would be extremely important**. This solution is more favourable from the aspect of the greenhouse gas emission even if the reprocessing requires the transport of the spent fuel to another country.

[57] Climate change and nuclear power 2015, International Atomic Energy Agency, September 2015

The vulnerability of certain facilities and of their certain elements to the impacts of climate change[58] is also an important issue. To define this, it is necessary to assess first of all the sensitivity, i.e. the fact how the condition of the system depends on the individual climate change parameters, and the extent of the presence of the various climate change processes at the geographic location of the facility in question (exposure). Since the life-time of the facilities in question is several decades or centuries, and also due to the nature of the radioactive waste (e.g. radiotoxicity reduces below the naturally occurring rate during several hundred thousands of years in the case of an open cycle as regards the spent fuel), in addition to the already detectable impacts, connection with impacts related to the climate change expected in the future must be also studied.

Within the primary climatic variables (average and extreme air temperature and precipitation, average and maximum wind intensity, humidity, solar radiation) and the secondary impacts, sudden snow melts, showers, floods, soil erosions, soil instability/landslides all affect theoretically the treatment of radioactive waste, mainly via impacts on the local properties and processes as well as on the traffic connections. As regards the depth subsurface facilities (NRHT, final disposal facility for high level waste), obviously the surface service facilities and the transport are exposed, and the KKÁT located on the area of the Paks Nuclear Power Plant situated near the Danube is obviously more exposed to floods than the other facilities. (In addition, among others, extreme temperatures, intensive atmospheric phenomena, strong winds and torrential rainfalls may also cause problems in the operation of the facilities.)

The nature of the National Programme (the fact that it is about mainly already existing and operating facilities) limits the possibilities to adapt. It is easy to recognise that it is possible to make preparations for the above events mostly during the planning phase (including the selection of the location, dimensioning and also the selection of the individual material types). Considering that in the case of all facilities and activities related to the use of nuclear energy, safety is the key aspect and planning and construction are performed with extreme care, the probability of the occurrence of accidents and damage events due to weather and climate causes is very low in the case of the facilities. As regards the transport routes and the traffic infrastructure, there is a higher risk (e.g. a sudden intensive rainfall washes away a bridge or erodes a road section), and the operators of the facilities cannot influence it. However, transport is not an urgent activity and can be rescheduled if such a problem occurs, and therefore this event does not cause a considerable problem.

4.3.2.2 Water

The expected impacts of the **planned modifications** (technology development, expansion) of the facilities are as follows:

- ***National Radioactive Waste Disposal Facility:*** The water regulation works of the area were performed during the preparation of the site, and it significantly rearranged the run-off conditions of the Nagymórágy Valley. The expansion of the disposal facility does not require water regulation works similar to the already performed works. The rock excavated from the new cuts may change the surface run-off conditions in the Hilda Valley previously designated for its storage. The dumped rock may have its effects for a long term since the rock material will be necessary again during the backfilling. The surface waters from the rock dump must be led to the Nagymórágy Valley. The water retaining effect of the ordered surface of the dump slightly reduces the surface water run-off and water discharges.

[58] Vulnerability is the product of the sensitivity and the exposure of the facility (element) in question, and indicates how the system is able or unable to resist the harmful impacts of the climate change at the geographic place in question.

Temporary loading of the surface watercourses is presumed during the rock excavation on the basis of previous experiences. Materials from the significant rock volumes excavated to the surface and from its debris enter also into small watercourses as a result of which their water becomes turbid and their suspended matter content increases. The impact is temporary and stops after the excavation of the rock. The new cuts may cause depression of the subsurface waters on the area. The base discharges of watercourses may reduce, sources/rills may dry up as a result of the depression in the valleys nearest to the cuts.

The expansion does not entail and extra water demand.

- ***Radioactive Waste Treatment and Disposal Facility of Püspökszilágy:*** The development of the site is not accompanied by significant water regulation works, and therefore the planned modifications and the works of the safety improvement programme will not affect the conditions of the surface and subsurface waters. Retrieval of the disposed waste may have a temporary loading effect, however, careful implementation should avoid the entry of pollutants into the soil and thereby into the natural waters.

  The developments will not entail a considerable extra water demand, and the currently operating water network is able to meet the demands in the long term.

- ***Interim Spent Fuel Storage Facility:*** The development of the site of Paks and its expansion with new modules do not affect the quantity and quality conditions of the surface and subsurface waters. The currently operating services are able to meet the increase of drinking water and industrial water demands of the site in terms of both water intake and wastewater treatment.

The registered and expected impacts of the **operation** are as follows:

- ***National Radioactive Waste Disposal Facility:*** This site has the greatest impact on the condition of the natural waters, but its extent is tolerable. As regards the surface waters, the extra water pumped from the depth to the surface during the operation is the quantitatively influencing factor. However, its volume affects the run-off of the creeks only in a 4-5 km zone of the site, and the run-off curves are straightening at further distances where the effect is not detectable.

  No radioactive water may come from the subsurface facility to the surface, and it is treated and stored under the surface after collection and cementing. The subsurface waters and the surface waters may not be exposed to radioactivity during normal operation.

  The volume of used communal water generated during the operation of the site does not considerable affect the volume of subsurface waters. The capacity of the network supplying drinking water to the site is currently sufficient, and will be able to meet the demand also after any expansion of the site. Sewage generated at the site is treated in accordance with the requirements.

  A significant part of the subsurface facilities of the site are located in the Mórágy Granite Formation. The system of fissures in the granite block provides flow routes of different sizes for the subsurface waters. The design of the disposal facility, the storage of the waste and the geological conditions of the receiving formation avoid the entry of polluted water from the facility into the environment. The deepened cuts have slightly changed the subsurface water flow conditions, but if the sizes of the cuts and of the geological formation are taken into consideration then this effect is negligible.

- ***Radioactive Waste Treatment and Disposal Facility of Püspökszilágy:*** A monitoring network is operated at the site for the monitoring of the groundwater. Water drawn from the wells is used for the necessary tests, its volume is negligible and does not affect the

groundwater level at all. No significant exposures from the site have been identified during the operation, the tritium level periodically appearing in the groundwater has increased, for the treatment of which a separate programme has been launched. No pollutions were released from the site into the environment.

Though it is a typically industrial facility, the site does not have separate industrial and drinking water. The drinking water is supplied to the site via a pipe connected to the water works located on the hill top, which forwards the water to the hydrophore tanks of the site by gravity. Considering the size of the site, it does not have a significant effect on the subsurface waters, the volume of the drinking water consumption is negligible, and the total water consumption is ca. 650 m^3 per year. This statement is not affected even by the development of the site.

– ***Interim Spent Fuel Storage Facility:*** During normal operation of both the existing and the planned facilities at the site of Paks, the subsurface waters are not exposed to pollution as this is excluded by the applied technologies. Pollutions from the technology may occur only in the case of damage events.

  During the period of operation, only the increased water intake is notable within the impacts affecting the stratum waters. During the period of operation, the impact of communal water intake on the subsurface water reserves is tolerable in terms of condition changes, and is negligible in terms of changes of use. Sewage generated at the site is treated in accordance with the requirements.

  As regards the Csámpa Creek, the Paks-Faddi Canal, the Faddi Dead Danube, the fish ponds of the Paks Anglers Association and the Szelidi Lake, the operation of the facility does not affect the measures specified in the Catchment Area Management Plan.

After **decommissioning and shut-down**, post-treatment is necessary in the case of each site, which includes also the monitoring of surface and subsurface waters. Subsequent use of the concerned sites remains significantly limited. The current operation does not have detectable impacts on waters, and detectable changes are not expected even after the shut-down of the facilities in the case of the sites of Paks and Püspökszilágy.

A significant impact is expected in the case of decommissioning of the National Radioactive Waste Repository. Here, the backfilling of the cuts will change the flow patterns of the subsurface waters again, though the backfilling must be implemented in a way that prevents down and up currents of the subsurface waters along the backfilled cuts. Rock volumes will be removed also from the interim dumps during the backfilling, and therefore the surface run-off conditions must be restored to their original conditions. This requires additional water regulation works. As a result of the backfilling, the volume of water pumped from the cuts to the surface reduces, in fact, to zero, and therefore the source of extra water affecting the surface watercourses ceases to exist.

4.3.2.3 Earth, soil, conventional waste

Earth, soil

Impacts of the **planned modifications**:

– ***National Radioactive Waste Disposal Facility:*** The planned expansion has significant impacts on the geological formation in the case of the site of Bátaapáti. The driving of new storage cuts entails significant rock excavation. The majority of the excavated rock is temporarily dumped as it is needed for the backfilling during the shut-down. It is stored on the dump located in the neighbouring Hilda Valley, previously designated and included also

in the settlement plan of the municipality. Dumping is implemented by means of valley filling, and would be partly sold on the basis of the previous practice.

- ***Radioactive Waste Treatment and Disposal Facility of Püspökszilágy:*** The planned interventions do not essentially affect the quantity or quality conditions of the soils. The planned developments will take place within the site, and affect soils that have been already exposed.
- ***Interim Spent Fuel Storage Facility:*** The storage capacity of the site of Paks has been continuously developed since its commissioning in 1997. Its further development is planned, but it will take place in a modular form in accordance with the previous practice, and so it will not entail soil pollutions. The planned developments will take place within the site, partly by optimising the already existing capacities which have, in fact, no detectable impact on the geological formation and the soils.

The impacts of **operation** are as follows:

- ***National Radioactive Waste Disposal Facility:*** It is the operation of the site of Bátaapáti that has the greatest impact on the geological medium due to its nature. Both the existence of cuts and the driving of new cuts modify the geological formation. The geological formation concerned is considered a disturbed space. The pollution impacts are mitigated by the fact that the sizes of the cuts are small in comparison to the size of the whole geological formation, and also that the backfilling is implemented by avoiding water up and down currents along the backfilled cuts.
- ***Radioactive Waste Treatment and Disposal Facility of Püspökszilágy:*** On the basis of the current operation practice, the facility does not have a considerable impact on the soils and the geological formation of the area. The soil pollutions experienced until now have taken place within the site, and did not have impacts on the neighbouring areas. If the technological development is implemented then the method of storage will be even safer, and the capacities will be used also more optimally. Thereby the soils will be exposed to less pollutions from both quantity and quality aspects.
- ***Interim Spent Fuel Storage Facility:*** The current operation practice does not affect the soils of the environment, and pollutions are possible only within the site. Impacts are presumed only within the site even if the further development is implemented, except for the impacts of the generated waste (the waste materials are covered by a separate part).

The **impacts of the decommissioning and shut-down** are identical at all places in the case of the surface facilities. The most important fact is that the use of the areas in question will not be possible for several decades after abandonment of the current activity. Therefore the soils of the areas may not regain their original functions either, and thus the use of land is considered permanent.

Treatment of conventional waste

In connection with the radioactive waste disposal facilities operating in Hungary we can state that there is no essential difference in the quality and the quantity of non-radioactive waste generated during the operation - several hundred kilograms of production waste - between the disposal facilities, and therefore the impacts can be jointly discussed, by activity if possible.

- **Impacts of construction:** Irrespective of whether it is the expansion of the radioactive waste disposal facility or the establishment of a new one, the top soil excavated during the

construction must be separately collected, and then used on the site or forwarded for use as a top soil after completion of the construction. Efforts must be made to use the additionally excavated soil during road constructions and landscaping. If the use cannot be solved, it must be transported together with the mixed building waste to an inert landfill.

As regards the construction waste, efforts must be made during the construction period to selectively collect the highest possible rate of the waste materials so that they can be utilised. Paper and plastic packaging materials must be also separately collected. These materials must be handed over for utilisation.

Hazardous waste must be also separately collected by type. Since there is a risk of environment pollution in the case of such waste materials the collection site must be designed in accordance with the effective legislation. Utilisation and disposal may be performed only by a licensed operator and therefore the waste must be handed over to a licensed company (companies). The necessary incineration and disposal capacities are available in the country. The communal waste must be disposed on the nearest municipal solid waste landfill in the case of each site.

Areas where waste materials are generated during the construction, operation and abandonment or are disposed are impact recipients from the aspect of waste management. During the construction period, the storage of the waste until delivery may cause changes in the condition of the geological formation. Impacts on the surface and subsurface waters may be excluded. Impacts may appear during the temporary land use by the waste storage facilities, and in the form of leakage or flow-off during the movement and transport of waste materials. In such cases, the polluting source can be clearly delimited, and the pollution is a single event. The source can be eliminated within a short time, and the pollution can be removed from the soil. The impacts can be reduced or avoided if the waste materials generated during the construction of the plant are collected and stored in accordance with the effective legislation and requirements, and the rules of waste management are observed. In that case, the effects will be minimum.

– **Impacts of operation**: Non-radioactive production hazardous and non-hazardous and communal waste generated during normal operation must be stored in licensed storage facilities designed in accordance with the purpose, the legislation and the requirements of the environmental (operational) licence until removal for placement or disposal. Proper treatment and storage excludes any environment pollution.

  If the above are observed, the impact of the generated waste on the environmental elements cannot be detected even in the direct vicinity of the waste disposal facilities.

– **Impact of decommissioning:** The abandonment plan of the disposal facilities must be drawn in view of the local features. This include factors such as the official requirements, possible abandonment solutions, possible future utilisation of the area, environmental impacts, accessibility of the waste disposal facilities, method of incoming delivery as well as the financing of the abandonment. Abandonment is accompanied by the demolition of buildings, cutting of the generated rubbish, disassembly of the technological systems and machines etc.

  Presumably, a solution must be found to the disposal of the following inactive waste materials during abandonment:

  • mixed demolition rubbish;
  • communal waste and mixed construction waste that can be treated together with it;
  • electronic waste;
  • non-ferrous metals, cable waste;
  • concrete waste cut up at the site;

- hazardous waste.

It will not be detectable if a solution complying with the legislation is found to the changes of the conditions of the environmental elements as a result of waste related to the decommissioning.

During operation, waste materials - mainly as a result of an accident - might be released into the environment or the soil. Their environmental impact can be minimised by immediately collecting the released waste and the polluted soil. The impacts of the damage events are identical to those of normal operation. If the damages are immediately eliminated in accordance with the "Damage Control Plan" necessary in the case of each facility, the risk of the damage event is tolerable.

4.3.2.4 Biota, ecosystems, with a special regard to protected natural and Natura 2000 areas

The expected impacts of the planned developments are as follows:

- ***National Radioactive Waste Disposal Facility:*** The planned developments affect basically underground facilities, which do not have an impact on the vegetation, the terrestrial, aquatic or water-related biota either directly or indirectly. Only the deposition of the excavated rock is an exception. If this is implemented in the previously designated and used Hilda Valley, then no impacts different from or more significant than those of the already implemented one will affect the neighbouring biota. The indirect impacts (dust pollution, change of run-off etc.) of the rock deposition area also identical to those of the previous activity. The environmental control activity following the implementation of the disposal facility did not detect any considerable unfavourable change in the region's biota.
- ***Radioactive Waste Treatment and Disposal Facility of Püspökszilágy:*** The developments planned in the facility are implemented within the plant's area, and do not increase the exposure of the region's biota. There is and was no significant natural value on the area of the facility, it was established on a former plough-land. The natural values of the grassland with scrubs situated directly near the site - an abandoned pasture - are not endangered by the normal and controlled operation of the facility. No unfavourable ecological impact of the RHFT on the natural biota is expected as it has not been detectable during its previous activities either.

  In the case of a damage event, assuming the release of radioactive pollutants, the fauna living in the creeks - mainly in the Szilágyi Creek - and the biota of the water-related habitats as well as the birds having a significant concentration role in the nutrition chain of the terrestrial ecosystems may become direct impact receiving and most sensitively reacting indicator organisations.
- ***Interim Spent Fuel Storage Facility:*** The expansion of the KKÁT is fully performed within the area of the plant, using a footprint of ca. 10 x 200 metres. No considerable unfavourable impact on the biota is expected during the implementation. The emissions of the operation affecting the biota will not change. (The nuclear power plant related thermal exposure of the Danube is the emission mostly affecting the biota, which is not influenced by the planned development.)

The expansions and developments planned in the studied Programme do not affect any Natura 2000 area either directly or indirectly. The same applies also the KKÁT necessary for the new blocks, which will be implemented within the site of the new blocks according to the plans.

Therefore no unfavourable impact is expected in the nature conservation situation of Natura 2000 habitants and species - as a result of the Programme -, no Natura 2000 impact assessment is necessary.

The locations of the planned new facilities (high level and potentially very low level disposal facilities) have not been designated in the current phase of the Programme. Therefore their impact on the Natura 2000 areas cannot be assessed at the moment. If possible, the use of nature conservation and Natura 2000 areas must be avoided. However, the selection of the location is defined fundamentally by the features of the site (the properties of the recipient) in the case of these disposal facilities, so this expectation may be overwritten by a public purpose. Efforts must be made to minimise the use of such valuable areas also in this case. If the establishment or operation of the disposal facilities may have a direct or indirect impact on Natura 2000 areas, drawing of a Natura 2000 impact assessment may be necessary as part of the licensing procedure on the basis of Government Decree 275/2004 of 8 October 2004 on nature conservation areas of European Community importance.

4.3.2.5 Built and urban environment

Urban environmental characteristics

The three sites affect three significantly different settlements in different ways:

– ***National Radioactive Waste Disposal Facility:*** Bátaapáti inhabited by less than 500 inhabitants, and therefore the less affected settlement might have undergone the greatest changes during the implementation of the NRHT. The hidden aging small village has become a nationwide famous, very prosperous settlement well provided with infrastructures due to the aid granted from the Central Nuclear Fund. The public institutions and public areas of the village have been renovated.

Image of Bátaapáti

The Apponyi Manor (Bátaapáti) before and after renovation

From the aspect of the settlement, the operation and the planned expansion mean that the 50-60 inhabitants will have permanent workplaces, and the support of the settlement is provided also in the long term. So the settlement can be permanently liveable.

– ***Radioactive Waste Treatment and Disposal Facility of Püspökszilágy:*** Püspökszilágy and the neighbouring settlements are small settlements, and the population of this settlement does not reach 800 inhabitants. The neighbouring settlements are also supported from the Central Nuclear Financial Fund, which is a significant help for these small settlements. This support will remain until the expected date of the shut-down of the disposal facility. Though the number of the employees is only several ten people, the facility is an important workplace in the region.

The entry of the disposal facility, with Püspökszilágy settlement in the background

Saint Martin Church (Püspökszilágy)

– ***Interim Spent Fuel Storage Facility:*** The KKÁT and the nuclear power plant are inseparable facilities from an urban environmental aspect. The life of the settlement is defined fundamentally by the situation of the nuclear power plant, the KKÁT has a minimum but important rule, since the number of its employees (several tens) is only a fraction of that of the power plant. As we have described in the presentation of the base situation, after a significant set-back, the several decades of uninterrupted development of the town is due to the establishment and operation of the nuclear power plant. The current favourable urban environmental situation will be provided by the end of the operation of the existing power plant (2030s) and, to a less extent, by the end of the abandonment (2060s). (The implementation of the new blocks will significantly extend these periods.)

The planned developments and expansions do not affect culture-historical and archaeological values. During the implementation of the new facility, the assessment of the exposure is indispensable.

When the liveability of the affected settlements is evaluated during the study of the urban environment, it is important to take into account how much the inhabitants feel safe. The National Programme details how the inhabitants in the vicinity of the facilities are involved in the control and how their readiness to receive is encouraged. An association has been established in each vicinity of all the three operating facilities as well as of the exploration area of the deep geological disposal facility, which is intended to make independent controls and to

provide detailed information to the population. These associations are: NRHT - Social Control Information Association with the involvement of 7 settlements, RHFT - Isotope Information Association with 5 settlements, KKÁT and the nuclear power plant - Social Control, Information and Resettlement Association with 13 settlements as well as the West Mecsek Social Information and Resettlement Association of the Local Government with 9 settlements. The proper awareness of the population is due also to the operation of these organisations, the inhabitants of the vicinity mostly accept the facilities, and hardly have objections to them. (This finding is always confirmed by the results of the biannually made opinion polls.)

In addition, communications and the increase of the readiness to accept are implemented via the operation of a visitors' centre and a show-room near the facilities, the organisation of information events and open days in the settlements, and the issue of publications intended to reach population groups beyond the narrow environment.

Noise

Noise is emitted basically in connection with the operation (and later abandonment) of the individual existing disposal facilities (plant's noise sources and transport) on the one hand and during the necessary expansions and the implementation of the new facilities on the other hand. Typically, the plant's noise sources cause noise levels above the limit-value only within the plant's area. Measures are taken in accordance with Joint Decree 27/2008 of 3 December 2008 of the Minister for Environment and Water and Minister for Health on the determination of environmental noise and vibration limit-values to make sure that the noise from the operating facility does not cause pollution above the limit-value on the areas to be protected against nose. As regards transports, the situation is different since in accordance with the above law the limit-values of traffic noise applies only to the new roads or roads to be reconstructed or expanded, while transports (may) affect inhabited areas, causing a problem especially where there was no considerable truck traffic before. Depending on the nature and location of the investment or facility in question, the impacts of the facility may be limited to noise pollution caused only by transports, but they may appear also at the site of the implementation and spread (e.g. drills, explosions). If despite all efforts, noise levels exceeding the noise limit-value specified in the above law for construction works are expected in relation to the objects to be protected, temporary limit-value exceedance permit may be requested from the regionally competent authority.

The followings can be stated on the noise pollution of the individual facilities:

– ***National Radioactive Waste Disposal Facility:*** The operational noise sources of the NRHT, the ventilation unit, the concrete plant (concrete pouring within a closed building) do not cause noise pollutions approaching the limit-value at the objects to be protected. The noise caused by the 1-2 trucks per day and maximum 15-20 cars per shift is a negligible extra pollution.

  The abandonment of the blocks of the nuclear power plant requires the supply of large volumes of waste presented in the chapter on air protection. Unfavourable impacts can be minimised with scheduled transports also in this case, and the introduction of the very low level waste category would be essential from this aspect. Thereby the volume to be transported to Bátaapáti would reduce (if this waste category is not disposed here subsequently). This problem does not arise in the case of an extended abandonment.

  The additional expansion of the facility - naturally entailing also noise pollution - is planned to be adjusted to the transport schedule of the nuclear power plant waste, the driving-out of the new storage chambers and then the construction of reinforced concrete vaults in the chambers are, in fact, continuously in process.

In addition to the operation of the machines, the abandonment, i.e. the backfilling of the system of cuts will entail also intensive transports, which will cause noise pollution reaching the level experienced during the establishment.

- ***Radioactive Waste Treatment and Disposal Facility of Püspökszilágy:*** The noise sources include the crane truck (operating on several occasions in a month), the safety related sources (detectors operating for several minutes in a month, and a diesel power generator used in the case of longer power failures), the operation of several machines (such as forklifts), building installations (air-conditioners, fans), and maintenance activities (workshop, lawn-mowing). Their emissions do not cause detectable noise pollutions in the vicinity of the nearest dwelling houses (Püspökszilágy, Kisnémedi).

  The impact of transport is not significant either, and currently the incoming volume is low, as we have presented it in Section 4.3.2.1 on the air. The traffic of 1-2 transport trucks per week and 15-20 cars per day is negligible even in the direct vicinity, and it is even lower along the transport routes.

  So there is no essential noise pollution either during the activities performed at the site or in connection with the necessary delivery.

  In the framework of the development of the RHFT, a hall of light structure equipped with a crane is planned to be constructed by 2017, and its construction will obviously entail noise pollution, however, it will not be considerable in view of also of the distance of the objects to be protected.

  Large volumes of waste materials to be treated are expected during the abandonment of the Research and Training Reactors in volumes presented in the chapter on the air protection in 2027 and 2033 as reference dates specified in the National Programme. This will not cause a considerable noise pollution either in the case of scheduled transports recommended in the air protection chapter. The situation is similar before the shut-down of the disposal facility when waste materials not intended for final disposal on the area of the RHFT are retrieved and delivered out. Unfavourable impacts can be mitigated with scheduled transports.

- **Interim Spent Fuel Storage Facility**: The spent fuel of the Paks Nuclear Power Plant is delivered to the neighbouring KKÁT by rail. Due to the not too high frequency of the transports and the short distance, this does not cause a considerable noise pollution. (The objects to be protected are situated at several kilometres.) Among the facility related operational noise sources, the nitrogen plant must be highlighted which does not cause noise pollutions above the permissible level in relation to the objects to be protected outside the area, but may cause such noise pollutions in relation to the objects to be protected within the area.

  The interim storage facility continuously operated and operates simultaneously with the expansion. Noise emissions are also expected during the expansion along the transport routes and at the site, but its rate is not significant.

  The interim storage of the spent fuel of the new nuclear power plant blocks is expected to be necessary from 2031-20136, and no decision has been made on the storage. The statement made in the chapter on air protection saying that national interim storage is more favourable applies also to noise pollution. In that case no long-distance transports are necessary.

  The waste materials stored in the interim storage facility (facilities) must be transported directly to the final disposal facility, unless they are reprocessed, and the storage facilities must be abandoned, and the generated waste transported to the relevant disposal facilities. The abandonment and the transport will entail noise pollution at a rate similar to the impacts of the establishment. The unfavourable impacts of the transport can be mitigated with extended abandonment and scheduled transports in this case again.

– ***Final disposal facility of high level waste:*** Significant noise pollution is expected during the preparation (exploration, drilling, explosion) and the implementation (particularly, rock excavation, transport) of the depth geological disposal facility to be implemented in the future, but the fact whether the impact zone of the construction affects areas to be protected and if so what exposures are expected can be assessed only in the knowledge of the location.

  During the operation, partly the supply and partly the activities displayed on the site (machines, ventilation, maintenance etc.) entail noise emissions. In the latter case, the mitigation of the noise pollution is ensured by pollution limit-values specified in the law for the noise emissions of the operating facilities. As regards the impacts of supplies, the fact that only small volumes are supplied is favourable. (See the chapter on the air protection.) Transport of large volumes is expected only after the abandonment.

  The establishment and operation of the depth geological disposal facility and, prior to that, of the subsurface research laboratory are activities subject to an environmental impact study. During this, the expected noise pollutions can be assessed and evaluated in the knowledge of the location and other parameters. At the same time, safe disposal must be the priority aspect in the selection of the location of the site.

Vibration

As regards vibration protection, first of all explosions related to the construction of the subsurface disposal facilities and freight transports must be studied in connection with the treatment of the radioactive waste. Both activities entail vibration impacts capable of spreading over long distances. The impacts of the former one are local, and as they appear rarely and for a short time, they do not belong to vibrations causing fatigue. The latter may affect a larger area, a long line of dwelling houses situated along the routes, and due to its frequency it is classified as a vibration causing also fatigue. As regards the waves induced in the upper half of the soil and spreading in the soil during the movement of vehicles, the force is defined by the mass, speed and suspension of the moving object. The vibration impact of vehicles with a mass less than 4 t is negligible, however, waves induced by large trucks (particularly, those with a weight over 20 t) and trains may entail significant vibration exposures. The individual building types and structures of various conditions are sensitive to the various vibrations in different ways. (E.g. adobe buildings frequently occurring in villages are more sensitive.) The generated vibrations are significantly affected also by the condition of the road (pitch-holes, ruts and other unevenness), and therefore **the good technical condition of the transport routes is important**.

– ***National Radioactive Waste Disposal Facility:*** Based on results of the in situ vibration tests performed in 2005-2006, the impact zone of the vibration exposure caused by the maximum 1-2 trucks - with a laden mass above 20 t - per day in connection with the current operation of the NRHT is limited to access road 56103 leading to Bátaapáti and its building standing by it. It must be noted that no waste supply to the disposal facility is planned in period 2042-2061, and therefore the above vibration load is not expected either.

  The expansion of the facility is planned to be adjusted to the transport schedule of the nuclear power plant waste, the driving-out of the new storage chambers and then the construction of reinforced concrete vaults in the chambers are, in fact, continuously in process.

  As we have detailed in the case of noise impacts, the abandonment of the blocks of the nuclear power plant significantly increases the waste volume to be supplied. Therefore maintenance of the used roads and vibration monitoring are important (also) from vibration protection aspects.

The abandonment of the disposal facility (backfilling of the system of cuts) will entail more intensive transports as in the case of establishment, and special attention must be paid to maintenance of the good road condition and vibration monitoring again.

We have to note that new buildings of better structure less sensitive to vibrations are expected to replace the particularly sensitive (e.g. adobe) buildings in the long term (abandonment of the new nuclear power plant blocks and of the NRHT).

- ***Radioactive Waste Treatment and Disposal Facility of Püspökszilágy***: In the case of the radioactive waste treatment and disposal facility, it is transport that is considered an activity causing vibration exposure. Currently, the supplied volume is low; as we have detailed it in the chapter on noise impacts, maximum 1-2 vans arrive per week, and due to their low mass the generated vibration is also lower.

  The supply of waste in volumes much higher than the current one is expected only during the abandonment of the Research and Training Reactor, and particularly the first one will have a high transport demand. Then a special attention must be paid to the quality of the roads used for transports.

  The transport demands will increase also in connection with the abandonment of the facility due to the waste to be delivered to the final disposal facility. The above will be valid again in this case.

- ***Interim Spent Fuel Storage Facility:*** As it is a surface facility, only the vibration impact of freight transport must be assessed in the case of the KKÁT. Vibration exposure measurements were made for the baseline situation in 2012 in connection with the preparation of the new block of the Paks Nuclear Power Plant. During the measurements, the impacts of the already existing facilities (such as the KKÁT) could be also mapped. The results indicated that within the vicinity of the nuclear power plant, the vibration spreads in the soil only over a limited distance, ca. 80-10 metres, and there is no object to be protected within this distance. At the same time, there is no information available on the vibration exposure of the operation of the KKÁT, but on the basis of the above, it is assumed that this does not raise concerns.

  The same is assumed also in the case of the interim spent fuel storage facility of the new blocks to be established, provided that a national interim storage is chosen finally.

- ***Final disposal facility of high level waste:*** Significant vibration exposure is expected during the preparation (exploration, drilling, explosion) and the implementation (particularly, transport of the excavated rock) of the depth geological disposal facility to be implemented in the future, but the fact whether the impact zone of the construction affects areas to be protected and if so what exposures are expected can be assessed only in the knowledge of the location.

  During operation, supplies will entail vibration impacts. From this aspect, the fact that only small volumes are supplied is favourable. The unfavourable vibration impact of the higher demand on supplies due to the abandonment can be avoided also with scheduled transports.

  The establishment and operation of the depth geological disposal facility and, prior to that, of the subsurface research laboratory are activities subject to an environmental impact study. During this, the expected vibration exposure can be assessed and evaluated in the knowledge of the location and other parameters. At the same time, safe disposal must be the priority aspect in the selection of the location of the site.

4.3.2.6 Landscape

The National Program takes into account only the operation and expansion of the existing plants and the development of the technology until its review. From the aspect of the landscape, this means that a situation similar to the current one is expected, and no considerable change either in the landscape or in the use of land is expected.

The expansion of the KKÁT is the only exception as it is made under the surface, and new modules will be built from the existing disposal facilities towards the Danube. Its impact on the landscape will be detectable but not considerable. (The appearance of the new modules is adjusted to that of the old ones.)

4.4 Forecast of factors having indirect impacts

In accordance with the content requirements of the SEA, indirect impacts that may occur as a result of the implementation of the National Programme must be studied in the document. These are evaluated by us mainly in the sustainability analysis. In the followings, the implementation of the National Programme is briefly evaluated by us according to the raised aspects on the basis of the legal expectations.

Appearance of new environmental conflicts and problems and intensification of the existing ones

Since waste treatment and disposal are solved basically with the further operation, expansion and development of the existing facilities in the National Programme, the appearance of new environmental conflicts and problems are not expected. The operation and environmental impacts of the three existing facilities are followed up with continuous radiological monitoring and periodical conventional environment controls. Their results do not indicate environmental conflicts at any site in the current condition. The planned development of the RHFT intends, among others, to increase the environmental safety, and therefore no intensification of any environmental problem is expected here either. The expansion does not increase the simultaneously supplied volumes in the case of either the KKÁT or the RHFT. Large-scale supplies are expected basically during the abandonment. In that case, extra exposures caused by the transports can be avoided with scheduled transports.

Any environmental conflicts can be minimised with the selection of the location and during the planning process in the case of the planned depth disposal facility of the high level waste.

This means that the implementation of the National Programme is not expected to cause the appearance of new environmental conflicts and problems or the intensification of the existing ones.

Deterioration or limitation of environment-conscious, environment-friendly behaviour, the possibilities and terms of lifestyle

The analysts of the SAE did not consider the National Programme as a solution that would deteriorate or limit the environment conscious behaviour or the lifestyle. At the same time, there is no sign of improvement either. Therefore we recommend the associations organised around the facilities to use their information channels for the popularisation of the environment conscious and environment-friendly behaviour and lifestyle. The visitors' centres, the information events and open days arranged in the settlements and the issue of regular publications also allow it. It is worth to use all tools to improve not only the acceptance of the facilities but also the environment consciousness of the population at waste disposal related facilities that are otherwise already environment-friendly. (A simple way is to use an

information material or an open day to cover the key topic of some environment-consciousness elements, or to issue the publications and brochures in newspapers, or to present the environment-consciousness commitments of the facility in the visitors' centres.)

Maintenance or establishment of deviations from the optimal space structure or land use method meeting the local features

The existing facilities have already created a specific spatial structure. It is a question if an optimal space structure was created during the establishment, the previous territorial structure has been essentially changed. The relevant studies have been implemented only in connection with the Paks Nuclear Power Plant. Here we can see that the land use has detectably changed and not in connection with the KKÁT but due to the establishment of the power plant. (The extent of the built in and industrial/service areas has significantly increased.) At the same time, the agricultural nature of the region has not changed despite the fact that the livelihood is provided basically not by this economic section any more in the region.

Due to their relatively small extensions, there is no sense in performing such studies at the other two sites. Small spatial structural changes can be seen also in their vicinities, but the settlements still live fundamentally on agricultural and forestry and the related forms of land use. (In Püspökszilágy, fruit production is a characteristic of the settlement in addition to arable farming, and in Bátaapáti, viniculture, forestry and wildlife management are the characteristics of the settlement.)

In the case of the depth disposal facility, the selection of the proper location can make sure that the spatial structural changes induced by the disposal facility are adapted to the local features.

So the facilities have not caused and the changes do not cause considerable restructuring of the local features. In the case of the RHFT and the KKÁT, it is recommended to plant forests of indigenous wood species in the vicinity of the site to increase the protection function. This will improve the ecosystem services and the landscape and reduce the possibilities of erosion and deflation.

Weakening of the local social-cultural, economic and farming traditions which accommodated to the landscape capacity to regenerate itself

The same applies as has been stated in the previous section. It can be seen again that the supports granted from the Central Nuclear Fund contributed to the strengthening of the settlements. This has helped also the revival of economic and farming traditions complying with the local features and traditions (in addition to other supporting elements). See for example the revival of fruit production in the vicinity of Püspökszilágy, or the strengthening of vine production in the vicinity of Bátaapáti.

Use of natural resources, limitation of their renewal

Similarly to the fossil fuels, uranium belongs to the non-renewable energy sources, its known reserves are sufficient for 100 years with the current rate of use and without a higher rate of recycling, however, in the case of reactors with fully closed cycles and fast neutrons this period increases to 5000 years.

There has been no uranium mining in Hungary since 1996. Currently, uranium is mined in 20 countries, the large producers (such as Australia, Canada, Kazakhstan, Niger and the Russian Federation) are located at significant distances from our country, which is unfavourable due to the long-distance transport demand also from the aspect of another non-renewable energy source, the mineral oil, in which our country is also poor.

The **economical use of the natural resources** requires the **application of a closed cycle** instead of an open fuel cycle - in harmony with the waste hierarchy - (even if this requires foreign reprocessing, i.e. fuel consuming transports.) Among them, **advanced reprocessing** (other, so-called actinides are also extracted in addition to uranium and plutonium) is more favourable, as soon as it becomes available. (Thereby the activity and the radioactivity of the waste to be disposed will be essentially lower, by the way!)

The transport demands may be reduced if the spent fuel of the blocks of the new nuclear power plant is stored in a national interim storage facility instead of a foreign storage facility. This recommendation is to be overwritten if reprocessing is also made after the interim storage.

4.5 Possibility and evaluation of the importance of impacts reaching beyond the country border

4.5.1 Aspects of the study of impacts reaching beyond the country border

Facilities intended for the interim storage of spent fuel and the final disposal of the radioactive waste fall under the effect of the Convention on Environmental Impact Assessment in a Transboundary Context signed in Espoo and Directive 83/337/EEC on the assessment of the effects of certain public and private projects on the environment. The mandatory use of the Espoo Convention is required by Government Decree 148/1999 of 13 October 1999 in Hungary. As regards activities indicated in Annex I to the Convention (such as the storage of spent nuclear fuel planned for a period more than 10 years), the countries considering themselves concerned may apply for the conduction of an international impact assessment procedure irrespective of the fact whether the impact zone includes the country in question on the basis of the analyses performed. In the case of activities mentioned in Annex II to the Convention (such as radioactive waste treatment and disposal facilities), the member states determine on the basis of a case-by-case study or thresholds or systems of aspects specified by the member states whether the project must be subjected to the assessment detailed in the Convention.

The definition of the impact reaching beyond the country border is specified in Government Decree 148/1999 of 13 October 1999, according to which the impact reaching beyond the country border is any, not exclusively global natural impact on the area under the jurisdiction of a party (country), which is caused by a planned activity the physical origin of which is fully or partly on the area under the jurisdiction of the other party (country). In the following, taking into account the expectations, we present which environmental elements and systems may be affected by the environmental impacts reaching beyond the country borders.

In order to be able to define the impacts reaching beyond the country border, we have to clarify impact factors and impact processes in connection with which spread over the country border is possible. The following factors have a key role in the assessment of the impacts reaching beyond the borders:

- impact factors which assume the possibility of spread over a large area,
- the ability of the impacts to spread and the sensitivity of the impact area as well as the ability of the impact zone to promote or inhibit the spread.

In order to assess the impacts, information must be collected on these factors. The importance of the impacts of an activity spreading over the borders may be assessed in the next steps:

- based on the place of installation, the nature of the activity and the applied technology, it must be decided if spread over the country border is assumable in theory.

- among the impact factors and impact processes of the given activity, those must be selected in the case of which initiation of unfavourable environmental - ecological processes spreading over the border is effectively assumed,
- the method and possibilities of the spread of impact processes initiated by the impact factors taken into account must be estimated, and based on this, it must be judged if they are able to spread over to the neighbouring country,
- if it is found in the previous step that impacts spreading over the border are possible, then the features of the affected impact area must be explored, i.e. it must be defined how the area in question is sensitive to the impact processes
- based on this, impacts really spreading over the country border must be sorted, and the importance of the impacts spreading over the borders must be assessed by comparing the impact processes and the regional sensitivity.

4.5.2 Study of the radiological impacts

4.5.2.1. Evaluation of the atmospheric emissions

In the case of the existing facilities, the possibility of atmospheric spread can be summarised for the individual facilities as follows:

- ***National Radioactive Waste Disposal Facility:*** As regards the NRHT facility, the country border closest to the disposal facility (Croatia) is at ca. 33 km. In the operational licence of the disposal facility[59], the competent authority specified 100 μSv/year as a dose constraint for the operation in relation to the population, and defined that the hypothetical group of children between 1 and 2 years living at 1000 m from the disposal facility and 10 m from the transport route would be the reference group in Bátaapáti.

  The consequence analysis of incidents contained in the licensing documentation of the disposal facility and belonging to the design base indicated that the radiation exposure of the critical population group is always below a dose constraint of 100 μSv/year. Therefore, no spread over the country border is expected.

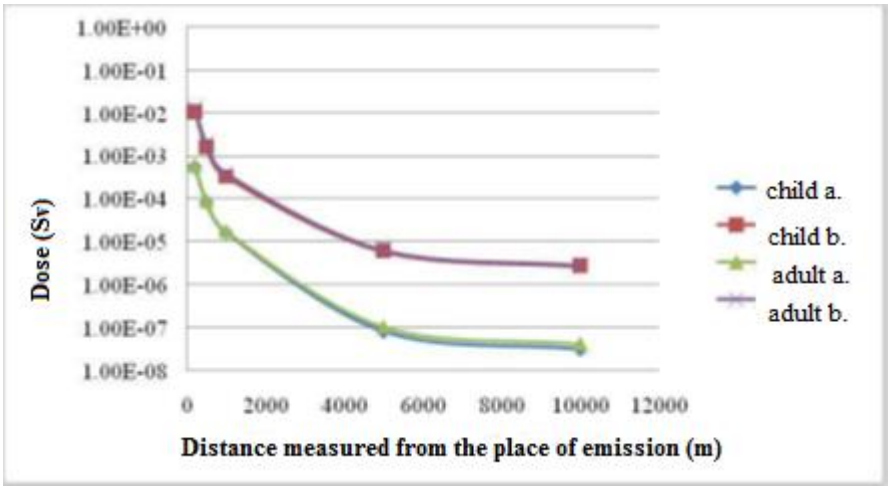
  In its opinion[60] of 2 September 2009 issued in compliance with Article 37 of the Euratom Treaty, the European Commission accepted that "the implementation of the plan related to the disposal of radioactive waste deriving from the national radioactive waste disposal facility to be established in the Hungarian Bátaapáti is not expected to cause radioactive pollutions in relation to any type of radioactive waste in the waters, soil or atmosphere of other member states either during the normal lifetime of the disposal facility or after its final shutdown or in the case of accidents of types and sizes assumed in the general data."
- ***Radioactive Waste Treatment and Disposal Facility:*** The border section closest to the site of the RHFT (Slovakia) is at ca. 35 km. The analysis of the incident event entailing the greatest dose consequences, belonging to the design base of the RHFT and applying conservative assumptions indicated that the total effective dose is below the reference level (100 mSv) related to the emergency radiation situation which is given in Section 9 of Government Decree 487/2015 of 30 December 2015 on protection against ionisation radiation and the relevant licensing, reporting and control system.

[59] Decision number XVII-084/00982-45/2012 of the Public Health Department of the Government Office of Tolna County on the issue of the operating licence of the NRHT

[60] The opinion (of 2 September 2009) of the Commission in compliance with Article 37 of the Euroatom Treaty on the plan related to the disposal of radioactive waste of the national radioactive waste disposal facility located in the Hungarian Bátaapáti

The radiation exposure of the small child and adult populations is indicated by ***Figure 4-14*** in function of the distance from the emitting sources (a) event - the plume spreads towards the settlement, (b) - the plume spreads towards the plough-land)[61]. As it is shown, with the increase of the distance the effective dose rapidly reduces below 1 μSv, and therefore - taking into account the distance from the nearest country border - we can state that no radiological consequences are expected beyond the border of the country.

Figure 4-14**Dose exposure of the population in the case of an assumed fire in the disposal facility**



Source: The operational safety report supporting the continued operation of the interim disposal facility of the RHFT (ÜMBJ), RHK–I–001/14, March 2014

– ***Interim Spent Fuel Storage Facility:*** Serbia located at 63 km is the closest to the site of the KKÁT implementing the interim storage of spent fuel, this is followed by Croatia at 75 km. The other neighbouring countries are situated at more than 100 km from the facility. (Romania 120 km, Slovakia 132 km, Slovenia 172 km, Austria 183 km, Ukraine 324 km.)

  Information indicated in the licensing documentation of the individual waste storage facilities approved by the competent authority in connection with the normal operational emissions was taken into consideration by us, and their summary is included in changer presenting the radiological environmental impacts of the facilities. Based on it, it is found that during normal operation no radiological consequences reaching beyond the country border are expected in any of the facilities intended for the implementation of the national programme, if the facilities observe the official emission limits derived from the relevant dose constraints, following the former operational practice.

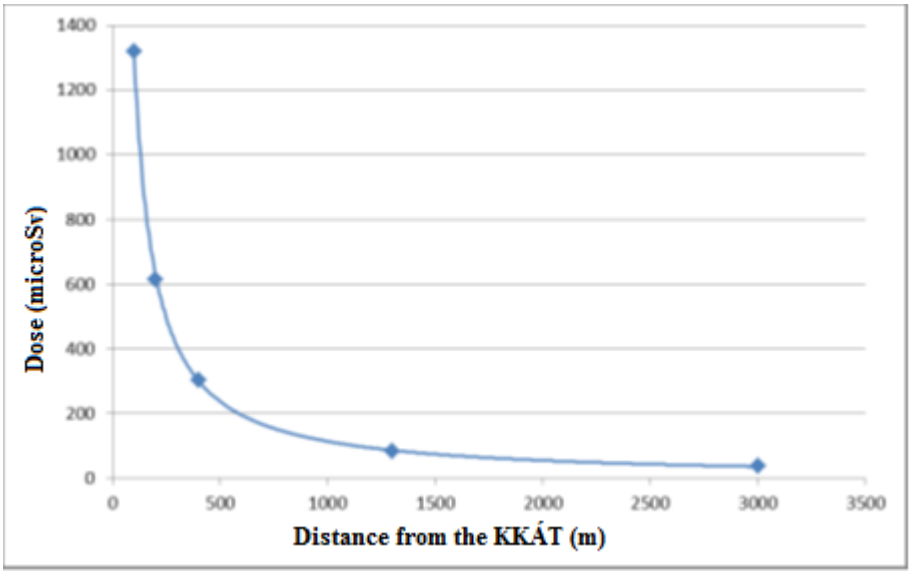
  Among the incidents belonging to the design base of the KKÁT, even incidents with the highest secondary doses do not result in damaging impacts specified in accordance with the qualification agreed upon with the authority in connection with the specification of the emergency situation of the environmental radiological impact zone of the KKÁT **at the fence at 100 m**. The impact causes an exposure at the fence at 100 m, and is tolerable at several hundred metres, while at a distance of **3000 m the impact belongs to the neutral category**[62].

[61] Source: The operational safety report supporting the continued operation of the interim disposal facility of the RHFT (ÜMBJ), RHK–I–001/14, March 2014

[62] Source: Performance evaluation of the renewal of the operational licence of the KKÁT, NPA85O01E0100O, Rev. 1. December 2014

Doses during operation deviating from the normal operation of the KKÁT in function of the distance measured from the KKÁT are presented on ***Figure 4-15***. **Considering the distance of the facility from the nearest country border (63 km), we can state with full certainty that no impact spreading over the country border is expected in the case of the most severe incidents belonging to the design base of the facility.**

Figure 4-15 **Doses in function of the distance from the KKÁT in the case of operation deviating from normal operation of the KKÁT**



Source: Performance evaluation of the renewal of the operational licence of the KKÁT, NPA85O01E0100O, Rev. 1. December 2014

4.5.2.2 Evaluation of the water emissions

No radiological water environment impact spreading over the country border is expected in the case of any facility included in the National Programme.

In accordance with the data given in the licensing documentation of the KKÁT implementing the interim storage of the spent fuel, the radiation exposure deriving from the liquid emissions during the normal operation of the KKÁT is 350 nSv/year for children and 210 nSv/year for adults in the case of the critical population group. These dose values are extremely low, and therefore any impact spreading over the country border is excluded.

Radioactive liquid emissions may be introduced into the environmental recipient only via connection to the systems of the nuclear power plant, and according to the analysis of incidents, the incidents do not cause direct emissions into the environmental recipient, any occurrence of incidents belonging to the design base will not increase the radiation exposure valid for normal operation and deriving from liquid emissions, and therefore any impact spreading over the country border can be excluded.

During the normal operation of the NRHT and the RHFT, adherence to the liquid emission limits derived from the dose constraints guarantees that the radiological water environmental impact on the inhabitants living in the vicinity of the disposal facilities is neutral, and thereby any impact spreading over the country borders can be excluded. The performed analysis of the incidents did not disclose any event that would result in an impact spreading over the country border via the radioactive pollution of the surface waters.

4.5.3 Evaluation of non-radiological impacts

As regards environmental impacts affecting the air quality, the surface and subsurface waters, the ground and the soil, the terrestrial and aquatic biota, the built and urban environment, and the landscape, or the expected noise and vibration exposure and waste management, the possibility of spreading over the country border is excluded in view of the great distances between the country border and the facilities.

5 SUSTAINABILITY ANALYSIS

5.1 Definition of sustainable development

Among the basic pillars of the system of environmental terms, the sustainability criteria demand separate explanations.

The definition of sustainable development has been specified in the following way in the Report of the World Commission on Environment and Development of the UN, "Our Common Future" in 1987: ***"Sustainable development is the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs."***

Act LIII of 1995 on the general rules of environmental protection also uses and defines the concept of the sustainable development:

> **Section 1(1)** The purpose of the law is to establish a harmonic connection between man and its environment, to protect the elements and processes of the environment, and to guarantee the environmental terms for the sustainable development.
>
> **Section 4** In terms of this Act
>
> w) sustainable development: a system of social-economic conditions and activities, which preserves the natural values for the present and future generations, economically and reasonably uses the natural resources, guarantees the improvement of life quality and maintenance of diversity in the long term from an ecological aspect.

Since the definition has been significantly improved since then, and the definition is general, we have to find a solution suitable for us:

- ***On the development:*** **The users of the definition interpret "development" as some improvement of life quality.** However, it may significantly differ from development used in economic terms. Our major problem, which can be observed during the analysis of the various, e.g. EN, EU, OECD documents, is that the definition of development is implicitly identical to economic growth, or rather the consumption patterns in these documents. A crucial element of market economy is the economic growth based on the growth of consumption, otherwise it is not able to operate. To put it simply: the concept of sustainable development often hides the endeavour: **to increase the consumption in a way so that the specific values of the used or affected natural resources reduce.**

  In our opinion, **development is a concept that can be interpreted only at the level of man and society**. From this aspect, **the purpose of development is to increase the cultural and ethnic levels while dignified living conditions and lifestyles are guaranteed**. **This latter is intended to guarantee also a proper self-control on part of man.**

- ***About sustainability:*** Sustainable development is a system of relations (culture) between the social and natural environments of man, which makes sure that the sources of our environment are used up to the level of the renewal of the system.

  In our case, sustainability must represent the ***internal self-control ability of the social and economic processes***, which provides the smooth operation of the environmental processes on the one hand, and helps to preserve the human values on the other hand. This means that as long as the social and economic processes can be diverted to the sustainable direction only with constant subsequent interventions, the applied system is not sustainable. This is where we face the basic conflict of sustainable development, i.e. the fact that the paradigm of the current market economy system contradicts the principles of sustainable development.

- *Sustainable development:* Based on the above, sustainable development is the increase of the standard of human life taking into consideration also internal values, which is in harmony

with the environmental and natural processes, and preserves also values created by man. This is the purpose of the society, and economy is a means, while the natural environment is a partner and a possibility. The purpose can be achieved only by applying general and complex means.

Principles related to the sustainable development have been specified, defined and accepted also by the EN and the EU at the highest levels. Among the generally accepted principles, the National Sustainable Development Strategy has highlighted the following ones due to their national importance:

- Principle of a holistic approach
- Principle of solidarity within and between generations
- Principle of social justice
- Principle of sustainability
- Principle of integration
- Principle of utilisation of local resources
- Principle of social participation
- Principle of social sense of responsibility
- Principle of precaution and prevention
- Polluter pays principle

5.2 Sustainable values and the sustainability analysis of the National Programme

A general set of criteria is presented in the following table, which is applicable as a requirement for planning. **The set of criteria has been made to provide a general sustainability reference for SAE type evaluation.** The criteria have been defined accordingly. The method has been used on several occasions, it is a well proven assessment/evaluation method, and has been suitable also for the evaluation of plans and programmes with very different contents after small changes.

The general environmental priorities and sustainability criteria are intended to form the attitude rather than to specify measurable and enforceable terms. The set of criteria applied also during other strategic assessments was changed to a set of terms related to the studied Programme in the second step. The table is indicated in column 3. In the same column, we are going to assess how the Programme is able to meet the individual terms. In other cases, we usually treat it independently, but in our case the programme does not contain actual developments, but contains principles, objectives and planning processes. As a result, our criteria also contribute to it. Only the possibility of compliance can be qualified instead of compliance itself. **So the criteria provide sustainability terms for future decisions.**

Table 5-1 **Interpretation of the sustainability critera for the evaluation of the National Programme**

Sustainability criteria		**Clarification and evaluation of criteria from the aspect of the National Programme**
I. Long-term balance must be achieved between meeting human needs and preserving natural and environmental values. *(a) the use of the environment should not exceed the rate of production of resources* *(b) the load on the environment should not exceed the assimilation capacity of the environment.*	1 The reserves and condition of the conditionally renewable environmental elements, which are considered as fundamental elements (air, water, earth, flora and fauna), the potential of the environmental system constituted by them and their self-regulating capability must be sustained within the load capacity limits of the system, and wherever this is necessary and possible, their load must be reduced in order to achieve the appropriate target condition.	Keeping the normal operational radiological exposure at the reasonable achievable lowest level means, in our case, that none of the affected environmental elements and systems is exposed to an impact considered worse than neutral, i.e. an impact which is interpretable and detectable from the aspect of a recipient and exceeding the fluctuation of the background exposure. This criterion is specified also in the Program among its principles, combining the maintenance of the reasonable achievable lowest level of the radiation exposure with the priority of safety. Conventional exposures and pollutions affecting the environment must be minimised in the case of each measure.
	2 A positive balance must be achieved in general between the values sacrificed and created in the management of natural resources, while the use of non-renewable resources must not exceed the rate by which they could be substituted with renewable resources.	A general precondition for the use of nuclear energy is that the social benefits provided by it must be greater than the risks endangering the natural person applying it, the employees working in the nuclear energy industry, the population, the environment and the material assets. This principle must comply also with the developments contained in the Programme, this criterion is represented by the set of principles of the Programme. During the interventions, resource saving (material, water, energy saving) solutions must be preferred. Efforts must be made to utilise the possibilities provided by the nature or the already existing ones against measures involving significant constructions and artificial interventions. Recovery, i.e. the use of the reprocessed fuel must be taken into consideration in accordance with the plans during future decisions. As regards the decision we can state that this is the more favourable solution from the aspect of sustainability criterion. Except that the total energy allocated to it is higher than the result of the savings.
	3 The amount and hazard level of materials returning to nature as waste (which cannot be utilised by nature either) must be decreased.	Efforts must be made to treat both the radioactive waste and other waste materials in accordance with the waste hierarchy (prevention; recovery, recycling; reduction of the volumes and hazard levels of waste to be stored or disposed). The possibility of the use of the reprocessed fuel must be taken into consideration as an option in accordance with the plans during future decisions. (See the above point.) The concept of very low level waste must be introduced as soon as possible, and its treatment possibilities and potential recovery must be regulated. The programme states that: *The user of the nuclear energy must make sure that the volume of radioactive waste generated during the activity is as low as possible.*
	4 When using the area available, the size of the areas which can be involved must be considered as a hard upper limit, and in the development projects, preference must be given to area conservation solutions. This must also be enforced at the regulation level.	Limited surface land use must targeted also during the establishment of the depth geological disposal facility and the expansion of the other facilities. Temporary land uses must be also minimised taking into consideration the sensitivity of the affected areas. Temporary land use may not affect precious (nature conservation, culture-historical etc.) areas.

Sustainability criteria		Clarification and evaluation of criteria from the aspect of the National Programme
II Processes entailing the loss of cardinal values must not be tolerated. *Each destroyed species takes away something from us.*	5 It is required to ensure the conditions for conserving biological diversity, the conservation and protection of natural endemic species and traditional cultivated or grown species, the sustainability of natural and close-to-nature habitats as well as their diversity and spatial coherence. This also serves the better adaptability of natural systems to environmental changes.	Damages to the ecological values of the region during the developments and their exposure during the operation must be avoided. Expansions and developments take place within the site, the operation did not cause such problems, so they are not expected to entail dangers in the future either. The establishment of the depth geological disposal facility can be solved theoretically with minimum surface disturbances. It is an aspect to be taken into account during the selection of the location.
	6 The ecosystem services should be considered values, their economic values should appear in the strategic development decisions. The development projects may not cause damage to ecosystem services.	It is not relevant as the development and expansion of the existing facilities do not entail such an impact, and the existing ones are partly and the facilities planned in the long term are fully subsurface facilities which do not affect the ecosystem services.
	7 The conservation of architectural, landscape and cultural values must be ensured.	During the developments, conservation of architectural, landscape and cultural values must be ensured. It has been taken into consideration during the establishment. In addition, minimisation of damaging impacts affecting the buildings and structures must be also targeted during the designation and establishment of the transport routes. This has been observed for example during the establishment of the NRHT in Bátaapáti.
III The possibility of adaptation to the natural and environmental changes must be provided at individual and social levels *One of the indispensable terms of economic, social, technical, individual, species and any other development is that it should serve adaptation to the environment. Otherwise the process will lead to the destruction of the subject in question.*	8 Adaptability to environmental (climate) changes must be retained at the level of both society and the population concerned, it must not be limited and, in fact, it must be improved as far as possible.	The use of the do and see principle must be taken into consideration not only during the final disposal of the spent fuel but also in the case of expansion and development of the other used facilities. This may be the proper means of adaptation in the case of the National Programme. This criterion is unimportant from the aspect of the purposes of the Programme. Though the whole nuclear energy generation process has a significant impact, the process of waste treatment does not have a significant impact as it operates in a rather closed system. (However, the expected climate change must be taken into account and solutions sensitive to the climate must be avoided during the planning phase.)
	9 Human activities intensifying the undesirable changes in the natural environment must be restricted or even prohibited subject to their impact and significance.	Not relevant. The waste management activity itself is intended just to avoid undesirable changes in the natural environment.
	10 The situation where a part of society lives in such poor living conditions that almost eliminates their adaptability and so they are able to survive only by consuming their immediate environment is not tolerable.	Actions supplementing the interventions are necessary which improve the landscape potential of the region, the acceptance level in the settlements and thereby their economic possibilities and the life conditions of the inhabitants in the case of the new facilities and preserves them in the case of the existing ones. This endeavour was observed in the case of each facility, and was most successful perhaps in the case of the NRHT. Interventions restricting the possibilities for living of the various settlements must be avoided. This term may be important mostly during the establishment of the national depth geological disposal facility.
IV The possibility of dignified living conditions must be provided for	11 Access to a healthy environment, adequate food and drinking water as well as reliable sustainable energy supply is an essential right of all people; non-compliance cannot be tolerated either locally or in a broader sense.	During the developments of the National Programme, the fact that this criterion (healthy environment, food, drinking water, safe energy supply) should be met, at least at a minimum level, must be taken into account. Calculations and modellings performed during the licensing procedures and safety reports related to the facilities confirmed the enforceability of this criterion.

Sustainability criteria		Clarification and evaluation of criteria from the aspect of the National Programme
everyone at their domiciles both now and in the future. *Development makes sense if, as a result, it will be better to live there.*	12 Local culture and the production and consumption patterns that have evolved during adaptation to the environment and ensured harmony between local communities and the environment in the long term must be preserved. If this is no longer possible, the establishment of sustainable production and consumption patterns must be supported.	Neither the expansion and technological development of the operating facilities nor the new facilities may change the nature of the region, and they must be adapted to the local circumstances in a way that preserves the local patterns. Due to the nature of the operating and planned facilities, this cannot be really expected, while the situation can be improved in connection with Point 10. The strengthening of the traditional local production patters has been also observed simultaneously with the development of the settlements in connection with the RHFT and the NRHT (see the RHFT fruit and NRHT vine cultures).
	13 The possibilities of the local communities regarding desired and optional modes of living must not be restricted because of the development projects, if these are not mutually exclusive and satisfy the requirements of both sustainability and development.	It is not relevant as the development and expansion of the existing facilities do not entail such an impact, and the existing ones are partly and the facilities planned in the long term are fully subsurface facilities which do not directly affect the mode of life on that level.
	14 Every activity related to environmental management must be carried out at a level where the handling of problems results in the greatest environmental and other benefits and the lowest environmental risk or damage.	Solutions entailing the least potential recipients to be taken into consideration due to the emissions/pollutions must be promoted. They should allow to limit or reduce the number of recipients to zero even after abandonment of the activity if possible, and to easily control the conditions of the remaining recipients in the long term. This expectation can be included in the principles of the National Programme.
	15 The use of resources manageable at the local level must primarily serve the direct or indirect benefit of the local community.	The population of the settlements receiving the facilities must be prioritised during the developments. The example of the NRHT should be noted again. The supports provided several benefits (such as the development of the infrastructure networks) for the settlements joining the Social Control Information Association. The attitude of the local community can be observed in the results of the opinion poll of 2015: http://www.tett-tarsulas.hu/files/static/kozvelemeny-kutatas-prezentacio-2015.pdf. This attitude must be achieved also in the case of the new facilities.
V Only a responsible man is able to achieve a sustainable development. *The improvement of the quality of life of individuals may not take place at the expense of environmental assets preferred either by the specific individual or others.*	16 The receptiveness of society must be strengthened (management of social exclusion, demographic problems, etc.) in accordance with the values.	During the developments (modification of the existing facilities and implementation on the new ones) and in the whole period of the operation of the facilities, continuous information supply to the population and the control of the impacts of the facilities with independent expert measurements are indispensable. The associations established in connection with the three existing facilities and the search for the location of the depth disposal facility are intended to provide updated and new information for the affected population. The awareness of the population is always assessed during the biannual opinion polls.
	17 The sub-region, region and town does not jeopardise the satisfaction of these requirements – either directly or indirectly – either in its own environment or more remotely, either in space or time.	Risks must not be passed to the future generations. The responsible and safe treatment of the spent fuel and the radioactive waste must solved by the generation which is the beneficiary of the nuclear energy use. Solutions resulting in reasonable and predictable exposures related to the further operation and closure of the systems for the future generations must be found. This is one of the principles of the Programme, that is the safe treatment of the generated radioactive waste and the spent fuel must be solved so that no challenge more severe than acceptable is passed to the future generations.
	18 The development project must have elements as a result of which the awareness of the principles of sustainability may grow and become moral standards in the members of the society, and simultaneously, in the course of planning, the engagement of the stakeholders in the decisions is ensured.	The measurements must be supplemented with elements improving a sustainable attitude and environment consciousness. The receiving regions and their inhabitants must be allowed to make independent controls in connection with the environmental pollutions/emissions. So a good practice is used by the existing facilities.

Sustainability criteria		Clarification and evaluation of criteria from the aspect of the National Programme
	19 It is necessary to spread sustainable consumption patterns, offsetting the current system, which encourages overconsumption.	
	20 From the aspect of sustainable development, the currently existing and continuously increasing property differences are unacceptable. There is no development without social justice.	If the implementation of the National Programme involves a less developed and disadvantaged region, efforts must be made to support developments offering possibilities to the inhabitants to make a difference. See Points 10 and 15.

6 SUMMARY EVALUATION OF THE NATIONAL PROGRAMME ON THE BASIS OF THE ENVIRONMENTAL AND SUSTAINABILITY REQUIREMENTS

6.1 Consideration of the environmental and sustainability aspects in the National Programme

The principles of the National Programme can be interpreted mostly as the environmental and sustainability aspects serving the protection of the environment, the nature and the human health. Among the environmental aspects, the priority of the human health and the environment, keeping the radiation exposure at the lowest reasonable level and the principle of minimisation of waste treatment must be highlighted. In addition, the principle of the reduction of the challenges passed to the future generations and of the final disposal of the generated waste within the country must be also highlighted from the aspect of sustainability. The National Programme has been made in accordance with the specified principles. According to the evaluation made by the SEA, the National Programme properly takes into account the environmental and sustainability aspects during the development of solutions related to the treatment of the spent fuel and the radioactive waste.

6.2 Summary evaluation of the combined impacts of the implementation of the National Programme

6.2.1 Environmental impacts

The activities planned by the National Programme involve mostly the operation of already existing facilities and, if necessary, their development and expansion. These interventions and the new facility to be implemented in the future, the final disposal facility of high level waste should be implemented so that the radiological impacts do not cause impacts other than neutral ones under normal operating conditions. These are impacts the existence of which can be confirmed (e.g. detected with a very sensitive instrument), but the change of condition caused by them in any environmental element or system is so small that the changes in them cannot be detected. The measuring networks operating at the existing facilities have not detected more significant impacts in the environmental elements and systems outside the site. The distance between the existing facilities makes sure that no cumulative impacts are expected.

Within the conventional environmental impacts, transport related ones may be significant, irrespective of the fact if materials are supplied for the construction or expansion, or fuel and waste are transported. Air pollution, nose pollution and vibration exposure caused by transports can be reduced by carefully selecting the delivery routes and limiting the traffic volume. The majority of conventional exposures can be well treated with technical devices.

Land use will be significant at the planned new depth disposal facility to be implemented in the future. In this case the rate of land use is defined by the territorial features, i.e. the fact if the receiving formation is suitable for the disposal of such waste materials. This may overwrite other aspects during the land use. Potential unfavourable impacts can be reduced by minimising the land use by the surface facility and by compensating them to the necessary extent. However, attempts must be made to avoid damages to natural values due to the development. This can be achieved by minimising the surface land use.

The distance of the existing facilities and the potential location of the planned new depth disposal facility under study from the country border makes sure that no significant impact spreading over the country border is expected.

6.2.2 Sustainability evaluation

As regards the summary presented in the table of previous Chapter 5, we must note that the current phase of the National Programme does not contain development decisions related to the implementation of the new facilities, which are postponed to later dates. Typically, it presents the consistency, targets and principles of the planning process, the schedule and theoretical alternatives of the process, using facilities already existing as a result of the planning process to date as a basis. The document is rather a strategy and not a concept from that viewpoint. Based on it, the Programme can be analysed for sustainability, and it is possible to assess the sustainability of the activities performed to date, and to establish what is expected in the future. In addition, the principles described in the Programme can be evaluated from this aspect.

The table contains the specification of criteria which must be followed by the Programme - that has been found acceptable by us - and which may appear as terms and aspects of planning during further planning of the developments. So these parts of the table are recommendations rather than evaluations. The experiences related to the existing facilities are favourable, the applied solutions are examples to be followed.

Before the summary of the evaluation it must be highlighted that the makers of the SEA may deal only with the sustainability of the Programme, and with the whole process of nuclear energy generation. The followings can be stated to summarise the evaluation remarks by group of criteria:

Group of criteria	Expected problems
I Long-term balance must be achieved between meeting human needs and preserving natural and environmental values	The National Programme does not entail problems difficult to handle from this aspect. No severe problems are expected on this area on the basis of the principles specified at the beginning of the Programme.
II Processes entailing the loss of cardinal values must not be tolerated.	Such problems have not occurred and are not expected to occur.
III The possibility of adaptation to the natural and environmental changes must be provided at individual and social levels	The radioactive waste treatment as an activity and its impacts are neutral from the aspect of the criterion.
IV The possibility of dignified living conditions must be provided for everyone at their domiciles both now and in the future.	Developments made to date confirm that favourable changes are expected from this aspect.
V Only a responsible man is able to achieve a sustainable development.	Based on the experiences, problems may be expected (in view of the deficiencies of the open planning practice observed in certain cases). This can be prevented with correct information supply in due time in the case of the planned facilities.

6.2.3 Summary evaluation

At the beginning of the study, in Section 1.3.3 presenting the tasks and major methodological aspects of the environmental assessment, we raised some questions which must be answered

by the environmental assessment. The following answers can be given to the questions in brief.

- ***Do we accommodate to the waste hierarchy with the solutions recommended in the Programme (prevention; reprocessing; reduction of the volumes and hazard levels of the waste to be disposed)?***

  The answer is yes on the basis of the environmental assessment. See for example the volume of spent fuel generated in the nuclear power plant since the introduction of the new fuel cycle, the compaction of the low and intermediate level radioactive solid waste and the processing of the liquid waste with LWT technology reduce the volume of waste to be disposed finally. Such measures include also the safety improving and capacity releasing and increasing activity performed in the KKÁT in Püspökszilágy as well introduction of the use of the planned compact waste packages in the NRHT. This may be helped also by the use of the reprocessed fuel in the new blocks.

- ***Are undesirable environmental and sustainability impacts expected? Do (radioactive and conventional) emissions and pollutions affecting the individual environmental elements/systems change, and if so, in what directions?***

  In accordance with Sections 6.2.1 and 6.2.2, no considerable changes are expected from environmental and sustainability aspects.

- ***Is the treatment of potential damage events solved at the proper level?***

  An analysis was made in the documentation supporting the licensing of the individual facilities on the basis of the conservative assumptions related to the radiological consequences of the incident and accident scenarios for both the operating staff and the critical population group. Based on this, no exposure of the critical groups above the permissible level is expected even in the case of such events.

- ***Is safety sustainable and controllable in the long term in the case of the final disposals?***

  No radiation exposure exceeding the specified official limits may affect the operating staff and the critical population group during the normal operation of the facilities or in the case of any conceivable incidents at the existing facilities on the basis of the performed evaluations. The individual facilities are monitored in accordance with the requirements of the Environmental Control and Emission Control Rules approved by the competent authority. The possibility of independent official and civil control is provided in the case of each facility. This latter is performed by associations established in the form of institutions at the existing facilities.

  The long-term radiological calculations were based on a careful calculation process complying with the international practice which was based on the analysis of the characteristics of the disposal system, the features, events and processes. These scenarios were studied also from the aspect of the safety functions of the disposal system on the basis of which a long-term safety model concept could be drawn. According to the long-term evaluations, the safety of the final disposal is guaranteed also in the long term.

- ***Are the liveability of the regions receiving the facilities and the satisfaction of the population expected to change?***

  The practice to date shows that the liveability of the receiving settlements has definitely improved. For example, the development of the municipal infrastructure is spectacular in the case of the NRHT. The acceptance of the operating facilities by the population is supported by the opinion polls. Due to the extensive information supply performed in the vicinity of the operating facilities, the favourable judgement by the affected population

may not change. This good practice must be followed also in the case of future developments.

- ***Do the recommended solutions sufficiently reduce the challenges passed to the future generation and promote the enforcement of the "polluter pays" principle?***

  The task to avoid challenges more severe than acceptable for the future generations belongs to the principles of the Programme. According to the principles of the Programme, the costs of the treatment of spent fuel and radioactive waste must be borne by those at whom the materials are generated. It also states that the radioactive waste generated in our country must be basically disposed in Hungary finally. Amounts deposited by the Paks Nuclear Power Plant in the Central Nuclear Financial Fund may be allocated only to the financing of tasks related to the treatment of the radioactive waste and the spent fuel as well as to the abandonment of the nuclear facilities, so the principle that this generation may not pass unreasonable challenges to the future generations is met. So the answer to the question is favourable.

- ***Is the protection of the environment and of the human health properly provided within the country and also beyond the country border both now and in the future?***

  Based on the licensing documentation of the individual operating facilities and the results of the continuous environmental control, we can state that the ***protection of the environment and of the human health is properly provided within the country and also beyond the country border both now and in the future***.

7 RECOMMENDATIONS: THE POSSIBILITY OF INTEGRATION OF THE RESULTS OF THE ENVIRONMENTAL ASSESSMENT IN THE NATIONAL PROGRAMME

7.1 Recommendations for the mitigation of the unfavourable impacts and for the improvement of the environmental and sustainability efficiency of the interventions

The new depth disposal facility surely and the planned developments (if the parameters specified in the previous licensing phase are exceeded) belong to activities subject to environmental impact studies. In this case, the environmental impacts of the facility must be thoroughly studied, and the recommendations for the minimisation of the unfavourable environmental impacts must be specified within the framework of this procedure. **Some general recommendations preceding the impact assessments and enforceable in them and in the planning processes are defined below:**

- **During the preparation of the abandonment plans**, mainly the air environment impacts, noise pollutions and vibration exposures caused by the demolition and by the necessary transports must be taken into account.
- Large volumes of waste must be **transported** (mainly transports related to the abandonment and other large-scale transports) always in a **scheduled way**, in view of the capacity of the transport route and observing the limit-values at the objects to be protected along the roads. The proper technical conditions of the transport routes are important for the reduction of the vibration exposures.
- **Conventional waste** is generated in the existing treatment and disposal facilities and those planned in the long term. **The expectations of the NWMP must be enforced** in the case of these conventional waste materials.
- The risk of the consequences of both normal operation and potential accidents may be reduced with **habitat and ecosystem service developments** in the vicinity of the sites. The habitat developments are beneficiary also from landscape aesthetic and landscape ecological aspects, and the erosion of the plough-lands surrounding the site can be also mitigated with them in the case of Püspökszilágy. The plantation of forests of indigenous wood species is the most favourable. (The site of Bátaapáti is an exception, where this protection function is ensured by the features of the area and the existing close-to-nature associations.)
- During the expansion of the NRHT, the use of lands covered by new, close-to-nature vegetations must be avoided when the rock from the new cuts are dumped, and the **area of the Hilda Valley** previously designated for this purpose **must be preferred during rock dumping**.
- From the aspect of the cost-efficient use of natural resources, the **closed fuel cycle** must be preferred (even if this requires foreign reprocessing, i.e. fuel-consuming transports). Among them, advanced reprocessing (when other, so-called actinides are also extracted in addition to uranium and plutonium) is more favourable, as soon as it becomes available. (Thereby the activity and the radioactivity of the waste to be disposed will be essentially lower by the way!)
- Storage of the spent fuel of the blocks of the new nuclear power plant in a **national interim storage facility** is to be preferred instead of a foreign storage facility. This recommendation may be overwritten if reprocessing is also made after the interim storage.

- **The introduction of the very low level waste category** is important, and we recommend to provide the necessary terms required in the law for this as soon as possible. For detailed reasoning see Section 7.4.1. It would be worth simultaneously starting the research/preparatory works to develop a method for their disposal.
- The **impacts of the expected climate change must be taken into account** during the selection of the facility intended for the final disposal of the high level waste and during the planning process as well as during the expansion and development of the existing facilities.

We recommend the associations organised around the facilities to use their information channels for the popularisation of the environment conscious and environment friendly behaviour and lifestyle. The visitors' centres, the information events and open days arranged in the settlements and the issue of regular publications also allow it. It is worth using all tools to improve not only the acceptance of the facilities but also the environment-consciousness of the population at waste disposal related facilities that are otherwise already environment-friendly. (A simple way is to use an information material or an open day to cover the key topic of some environment consciousness elements, or to issue the publications and brochures in newspapers, or to present the environment consciousness commitments of the facility in the visitors' centres.)

7.2 Recommendation for the aspects to be taken into account in other plans affected by the investments and in the programme

The completion of environmental works in the planning process of the depth disposal facility is time-consuming. Therefore, it is important to start to **collect the base data** within minimum 2 or 3 years, or, if possible, 5 years before the planned acquisition date of the licence.

The **impact process figures** indicated in the SAE can serve as a **guide** for the drawing of the environmental impact studies during the environmental licensing procedures.

7.3 Environmental control related to the National Programme

The majority of the measures included in the National Programme are based on already existing facilities, therefore experiences gained in the operation of these facilities and the national system of environmental measures that provides the necessary data for the assessment of their environmental impacts have a key role in the assessment of their impacts.

Proper monitoring, modernisation and updating of the monitoring tools and sampling procedures must be still provided for the safe operation of the KKÁT and the disposal facilities so that the radiation exposure of the operating staff remains within the permissible limits and at the lowest reasonable level, and the environmental impacts can be minimised.

Based on Government Decree 489/2015 of 30 December 2015 on the control rules of environment radiation situation defining radiation exposures of natural and artificial origin affecting the population and on the volumes to be measured, the results of the national measurement of environmental radiation conditions defining the natural radiation and the artificial radiation exposure other than a medical one and of the activity concentration of certain radionuclides measurable in the environment (hereinafter referred to as the monitoring data) are collected, recorded and evaluated, and the radiation protection official control

programmes related to the environment of the highlighted facilities are coordinated by the National Environment Radiation Monitoring System (hereinafter referred to as the NERMS) under supervision by the HAEA. Data received and processed by the NERMS Information Centre are included in annual reports[63]. The MVM Paks Nuclear Power Plant (MVM Paksi Atomerőmű Zrt.) and the RHK Kft. take part in the measurements and the data collection as organisations providing measurement data.

More detailed and more explanatory summaries are provided in the articles and reports made on the activities of the measuring networks of the individual divisions and the environmental controls of the individual facilities than in the data provided in the reports of the NERMS.

The SEA draws the attention to the necessity of the continuous modernisation of the NERMS measuring network so that it can ensure the environmental controls related to the National Programme and thereby the environmental assessment of its impacts in the long term.

In addition to the control of the radiological impacts, it is important to regularly (every 8-10 years) assess also the conventional environmental situation in the framework of an environmental review at these facilities requiring special attention. Thereby the tendencies of the environmental condition change will be traceable in the vicinity of the facilities also in the long term.

7.4 Other recommendations

7.4.1 Problems related to very low level waste

Based on the international experiences, the category of the very low level radioactive waste (VLLW) is worth introducing as soon as possible for economic reasons, since if a disposal facility suitable also for the disposal of VLLW, no waste is disposed on the disposal facility of the low and intermediate level radioactive waste (LILW) which can be safely and often more cheaply disposed elsewhere.

As a result of the new endeavours, the VLLW as an independent category has appeared already in the safety guide[64] of the waste management system of the International Atomic Energy Agency (IAEA), in which its introduction is recommended for the member states.

The National Programme states that currently the effective national laws do not contain the very low level waste category, which is, however, present in the waste classification system of the International Atomic Energy Agency. Several supporting studies have been made to present the circumstances and the requirements based on which it would be advisable to introduce the very low level waste category in Hungary. By summarising the analyses made to date, a summary must be drawn based on which the necessary modifications of the laws can be started, and a concept related to the final disposal of very low level waste can be developed in view of the graded approach. Optimisation must be made in view of the two radioactive disposal facilities operating now in all cases. After the development of the concept, the National Programme must be supplemented with this area.

The National Programme defines key milestones expected in the next 5 years to follow up the progress. It recommends 2020 as a milestone date for the introduction of the very low level waste category - i.e. the development of the concept related to the final disposal of the very

[63] The results and annul summary reports of the NERMS http://www.okser.hu/eredmenyek/eredmenyek.html

[64] IAEA "Classification of Radioactive Waste", IAEA General Safety Guide GSG-1, IAEA Safety Standards Series GSG-1, IAEA, Vienna, 2009.

low level waste and based on it the introduction of the necessary modifications of the legislation.

In 2013, the RHK Kft. made a proposal[65] on the possibilities of the introduction of the very low level radioactive waste category and the disposal of such waste materials. The RHK Kft. studied the cost effects of the establishment of the very low level waste disposal facility, the result of which has shown that the establishment of such a disposal facility would have economic benefits. By summarising all the assumptions and results of the analysis, the study has found that it is worth to consider the acceptance of a strategic version which contains the establishment of a very low level waste disposal facility, but the preferred strategy cannot be selected on the basis of the current information, and it is possible to make a reasonably supported proposal only after significant reduction of the uncertainties.

The analysis has shown that the establishment of the very low level waste disposal facility will have positive impacts not only during the abandonment of the current nuclear power plant but also during the operation of the planned new nuclear power plant blocks. Therefore the year of 2020 as a milestone date recommended by the National Programme for the introduction of the category is not favourable from the aspect of the requirement included among the criteria of sustainability and targeting the reduction of the waste materials to be stored and disposed. According to the above proposal of the RHK Kft., a minimum period of 10 years is necessary for the licensing, planning and construction of the VLLW disposal facility. However, as a result of this, the VLLW disposal facility will not be available for several years after the commissioning of the new nuclear power plant blocks in accordance with the plans (2025, 2026), and due to this a part of the generated operational waste materiasl will be transported to the disposal facility of the NRHT possibly in a less cost-efficient way, though its activity content does not require subsurface disposal meeting more stringent requirements and thereby being more expensive. Similar statement can be made in relation to a part of the waste materials retrieved during the safety improvement measures of the RHFT in process: if they belong to the very low level category then they can be transferred to the VLLW disposal facility, releasing additional valuable storage capacity for the low and intermediate level waste to be disposed in the RHFT.

In view of the above aspects, **the SEA recommends 2017 as a milestone date for the establishment of the legal background necessary for the introduction of the very low level waste category instead of 2020 currently indicated in the National Programme.**

7.4.2 Additional construction possibilities of the NRHT

The National Programme contains information on the waste materials of the new Paks Nuclear Power Plant blocks and makes a recommendation in relation to the low and medium level categories for their disposal in the NRHT facility operating in Bátaapáti.

The low and intermediate level waste generated during the operation and abandonment of the two nuclear power plant blocks to be established at the site of Paks have significant impacts on the design of the NRHT from both quantity and time schedule aspects.

In accordance with the content of the National Programme, a sufficient storage capacity can be established for the disposal of the operational low and intermediate level waste materials of the new nuclear power plant blocks in the remaining storage chambers available in the chamber field I of the NRHT. However, in that case a storage capacity different from that

[65] Proposal for the strategy related to the national implementation of a very low level radioactive waste disposal facility, RHK Kft., SMI-002/13, March 2013

given in the plans made to date has to be established for the low and intermediate level waste materials from the demolition of the existing four blocks of the Paks Nuclear Power Plant by expanding the NRHT.

In connection with the disposal of the extra waste volume deriving from the new blocks, the RHK Kft. considers it reasonable to review the expansion concept of the NRHT made previously, in 2007 on the basis of the new geological information and the establishment and operational experiences.[66] In 2014, the RHK Kft. started to assess the expansion possibilities of the NRHT. Several preliminary arrangement versions were made, where the currently known geological-hydrogeological features as well as the geometric and technological features of the already established storage parts were taken into account.

The study of the expansion possibilities of the NRHT are still in process, a summary evaluation will be finished by the mid of 2016 which characterises, evaluates and ranks the potential areas, taking into consideration the uncertainties of the information, the possibilities of the exploration and approach of the area, its relation to the already operating storage parts, and also the operational and long term radiological safety aspects. The summary evaluation is intended to support the decisions related to the expansion strategy of the NRHT.

The National Programme includes the research & development demands of the operation and expansion of the NRHT among the research & development tasks related to the disposal of the radioactive waste. It foresees an exploration with drills under the surface to designate the optimal expansion direction in connection with the expansion of the NRHT. The National Programme recommends to update the dose calculations related to the various development scenarios based on the latest international information and the new numerical modelling possibilities during the safety reviews to be performed periodically.

The National Programme defines key milestones expected in the next 5 years to follow up the progress. As regards the NRHT, the milestones include the commissioning of storage chamber I-K2 in 2017, which will be suitable for the receipt of compact waste packages generated by the Paks Nuclear Power Plant. Beyond this, however, **an additional milestone related to decision-making in connection with the expansion strategy** would be reasonable concerning the NRHT to support the disposal of the waste materials of the new blocks of Paks. For that purpose, the **SEA recommends** to make a **safety evaluation supporting the decision** on the basis of the currently available parameters of waste materials of the existing and new blocks of Paks for the above outlined version(s) preferred by the summary evaluation studying the expansion possibilities of the NRHT, **based on which the decision on the expansion strategy can be made at the end of 2017 or at the beginning of 2018**.

[66] Source: Document supporting the reconstruction. Deepening of exploratory drills in the controlled zone of the NRHT of Bátaapáti, RHK Kft., RHK-K-073/15, October 2015

8 NON-TECHNICAL SUMMARY

On the basis of the expectations of Council Directive 2011/70/Euratom of 19 July 2011 and of Act CXVI of 1996 on the nuclear energy, the Hungarian Parliament adopted a **document on the national policy of the treatment of spent fuel and radioactive waste in its Decision 21/2015 of 4 May 2015** (hereinafter referred to as the National Policy). The implementation of the purposes of the National Policy must be presented in the National Programme, which must be reviewed every five years (or more frequently if necessary). On the basis of the legislation related to the ready National Programme, an environmental assessment (generally referred to as the strategic environmental assessment, hereinafter referred to as the SEA) must be made. This part summarises the SEA in a non-technical way.

In this case, the basic task of the SEA is to study if the issue of the treatment of the spent fuel and radioactive waste can be properly solved from environmental and sustainability aspects in accordance with the National Programme. (This study is not intended to take a position in the debate about the use of nuclear energy.)

The environmental assessment was performed by the experts on the basis of the agenda required in Government Decree 2/2005 of 11 January 2005 on the environmental assessment of the individual plans and programmes and agreed upon with the competent authorities in November-December 2015. The relevant EU guidelines, the national legislation, programmes, plans as well as previous licensing documentation and reports related to the existing facilities were used during drawing of the SEA.

The radioactive waste disposal facilities operating in Hungary have environmental, establishment and operational licences. All facilities display their monitoring activities in accordance with the requirements of the Environmental Control and Emission Control Rules approved by the competent authority. The environmental baseline situation in the vicinity of the disposal facilities was defined before the establishment and commissioning. The results of the control measures performed regularly in each year in accordance with the programme and documented in annual reports in accordance with the official licences are compared also to them. So the impacts can be assessed not on the basis of estimates but of actual environmental data in relation to the operating facilities.

8.1 BRIEF PRESENTATION OF THE NATIONAL PROGRAMME

The National Programme related to the treatment of the spent fuel and the radioactive waste was made on the basis of the National Policy, which specified the policy related to the closure of the fuel cycle, to the treatment of the radioactive waste and to the abandonment of the nuclear facilities as well as the boundary conditions of the Programme.

The National Programme has been made in accordance with the content requirements of the relevant EU Guideline and in view of the following principles:

– **Protection of human health and the environment**: The nuclear energy must be used in a way that does not endanger human life, the health, life conditions of the current and future generations, the environment and material assets beyond the socially acceptable risk level assumed necessarily also during other economic activities. A general precondition for the use of nuclear energy is that the social benefits provided by it must be greater than the risks endangering the population, the employees, the environment and the material assets.

- **Priority of safety**: Safety has a priority against all other aspects during the use of nuclear energy, i.e. the activities covered by the National Programme (treatment of radioactive waste and spent fuel as well as abandonment of nuclear facilities).
- **Reduction of challenges passed to the future generations**: During the use of nuclear energy, safe treatment of the generated radioactive waste and the spent fuel must be guaranteed so that no challenge more severe than acceptable is passed to the future generations.
- **Minimisation of the generation of radioactive waste**: The user of the nuclear energy must make sure that the volume of radioactive waste generated during the activity is as low as possible.
- **ALARA principle:** It is an acronym deriving from English term "As Low As Reasonable Achievable", which means keeping the radiation exposure as low as possible.
- **Final disposal of radioactive waste generated in the country**: Radioactive waste generated in Hungary and the high level radioactive waste deriving from the processing of spent fuel generated during fuel use in Hungary must be finally disposed basically in Hungary. (Except when there is an effective agreement with a country undertaking final disposal at the time of delivery, according to which the radioactive waste generated in our country can be delivered to the radioactive waste disposal facility of the country in question for final disposal.) In this case, the respective national regulation contains further conditions in order to ensure that safety of disposal in third country shall be equal to the safety of inland disposal solution.
- **"Polluter pays" principle:** The costs of the treatment of spent fuel and radioactive waste must be borne by those at whom the materials are generated.

The National Programme has specified the volumes of spent fuel and radioactive waste generated until 1 January 2015[67] and to be generated in the future. According to the National Programme, the operation and technological development and, if necessary, the expansion of the Radioactive Waste Treatment and Disposal Facility (RHFT) of Püspökszilágy, the Interim Spent Fuel Storage Facility (NRHT) of Paks as well as the National Radioactive Waste Disposal Facility (NRHT) of Bátaapáti are suitable for the processing of the waste materials generated in the future, for the treatment and final disposal of their volumes and for the interim storage of the spent fuel. (The logical scheme of the treatment of the spent fuel and the radioactive waste is summarised by the National Programme on the following ***Figure 1***.)

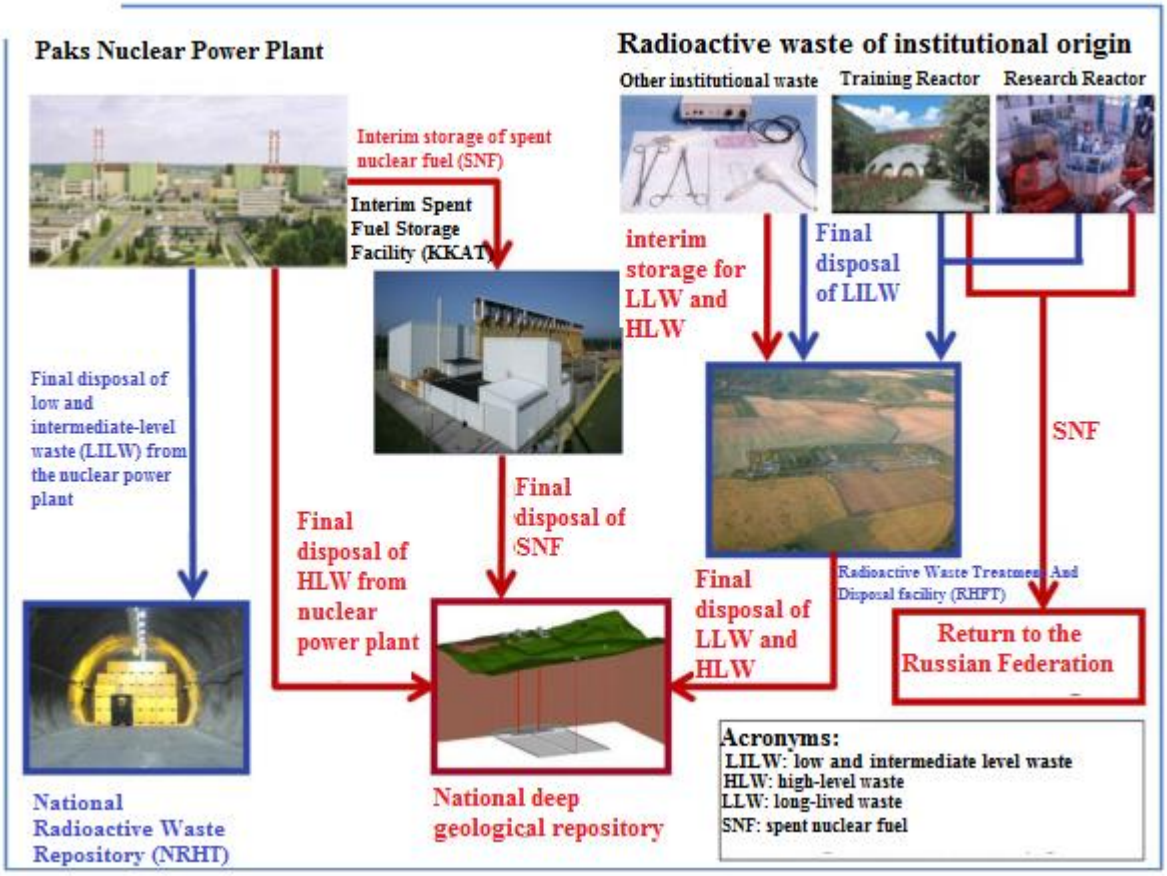
Two disposal facilities operate in the country for the **final disposal of low and intermediate level waste**; those of institutional origin are received by the RHFT and those of nuclear power plant by the NRHT:

- The operation of the **RHFT of Püspökszilágy** started in the 1970s in accordance with the then requirements. To make sure that the site meets today's expectations, the organisation liable for the treatment of radioactive waste, Public Limited Company for Radioactive Waste Treatment (RHK Kft.) has been continuously developing the technology and the safety systems since its foundation. During the last 10 years, all the waste treatment units have been renewed, the buildings renovated and the measuring devices replaced with new ones. The review of the safe disposal of waste packages received by the RHFT decades ago started with a comprehensive evaluation in 2000 to improve safety. As a result, resorting, repackaging and simultaneous compaction of the waste disposed 30-35 years ago started.

[67] 1 January 2015 is the reference date of the National Programme.

This results in the release of new storage capacity, and therefore radioactive waste generated in the different institutions can be received for several decades. In the first phase of the programme, four storage vaults were emptied for demonstration purposes, the waste materials were resorted, reprocessed and then disposed again by 2010. The safety improvement and capacity release activity cover works to be performed until the mid of the 2030s.

Figure 1 **Logical scheme of the treatment of spent fuel and radioactive waste**



Source: National Programme

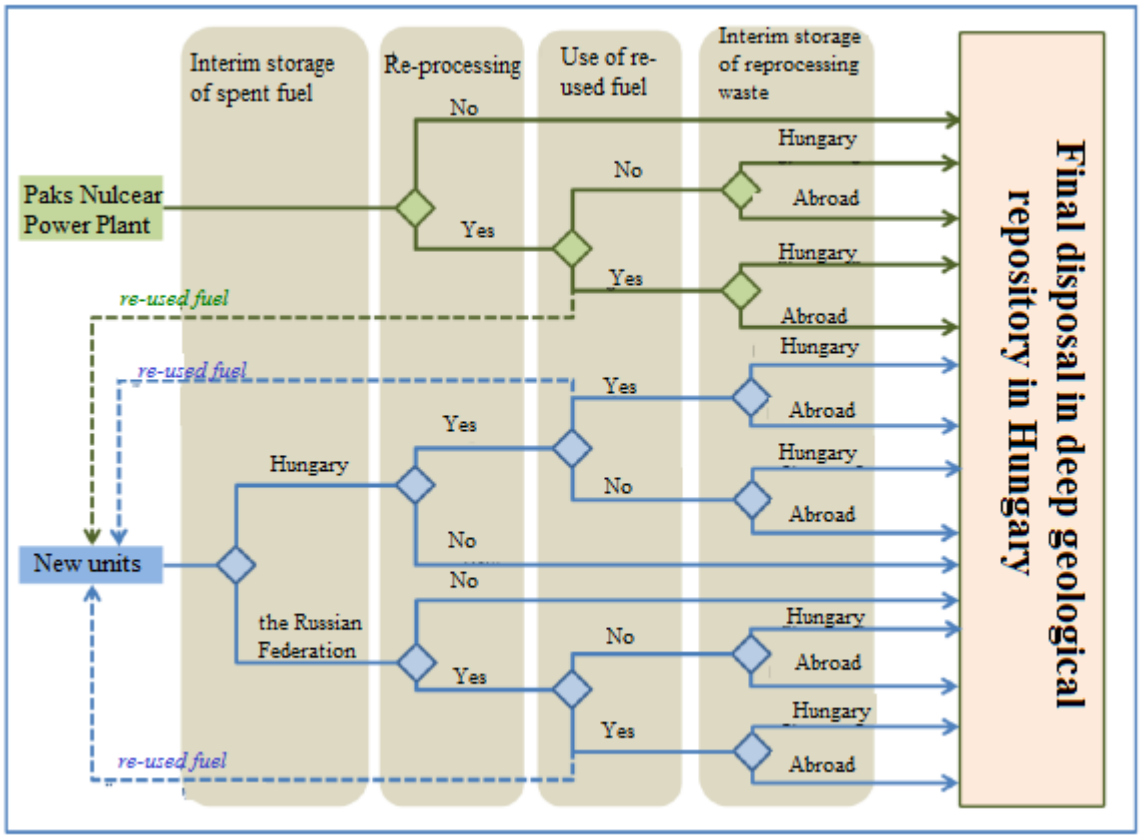
– The **NRHT** situated on the administrative area of **Bátaapáti** has been established in several phases. The surface facilities, the central and the technological buildings were finished by the mid of 2008 in the first phase, the disposal facility receives solid waste accumulated in the Paks Nuclear Power Plant since then. The first two storage chambers were constructed, and the servicing technological systems were built by 2012, in the second phase of the implementation. The space intended for the final disposal - and located 250 metres under the surface - is accessible via approach cuts, each with a length of 1700 m and a slant of 10%.

  The final disposal of the radioactive waste started in storage chamber I-K1 in the possession of the operational licence. The additional expansion of the facility is planned to be adjusted to the delivery schedule of the waste of the nuclear power plant. The driving-out of storage chambers I-K3 and I-K4 made with mining methods was finished in 2015, the reinforced concrete vault constituting a part of the disposal system must be built in chamber I-K2 in 2016 so that it can be commissioned in 2017 in compliance with the delivery schedule of the Paks Nuclear Power Plant.

– The interim storage of spent fuel generated in the existing blocks of the Paks Nuclear Power Plant is implemented in the **KKÁT** facility established at the site of **Paks**. It is a modular, dry disposal facility with chambers, and was commissioned in 1997. The disposal facility is continuously expanded in accordance with the disposal demands. The interim storage of the spent fuel of the new nuclear power plant blocks can be implemented in the new national and foreign disposal facilities licensed for the receipt of the spent fuel in accordance with the National Programme.

Today, there are basically two concepts in the international practice for the closing section of the nuclear fuel cycle: direct disposal of the spent fuel (open fuel cycle) and reprocessing to some extent. As regards the nuclear fuel cycle closing section of the nuclear power plant, the National Programme intends to use the "do and see" principle. (The decision points are indicated on ***Figure 2***.) This means that direct national disposal of the spent fuel has been specified as a reference scenario, however, this could be changed in view of the national and international changes and in the knowledge of the arising new possibilities. A research framework programme must be developed for the research, development and demonstration activities related to the final disposal of high level and long-lasting radioactive waste, which includes also a geological research programme intended to confirm the geological suitability of the site.

Figure 2 **Decision points related to the closure of the nuclear fuel cycle**



Source: National Programme

8.2. MAJOR RESULTS OF THE ENVIRONMENTAL ASSESSMENT

The SEA made its evaluation on the basis of three major aspects:

- **It studied compliance with the relevant national and EU environmental policy objectives**, i.e. if the National Programme is harmonised with the EU and national environmental policy objectives.
- It **identified** the major radiological and conventional **environmental impacts** of the existing facilities recommended by the **National Programme** for further use and of the new ones. Considering that this programme is basically about the expansion and development of the existing facilities, it was possible to study adherence mainly to the radiological limit-values in a numeric way. (This could be performed on the basis of the results, environmental performance evaluations and review documents of the official and independent measures obtained in the vicinity of the existing facilities.)
- The SEA established **sustainability values**, a set of sustainability criteria, and examined also compliance with the Programme in accordance with the individual criterion, i.e. if the recommended measures help or hinder the implementation of the sustainability criteria.

The major findings of the performed evaluation can be summarised as follows:

8.2.1 Harmony between the National Programme and the environmental policy objectives

An independent chapter of the SEA analysed the harmony between the National Programme and the environmental policy objectives specified in the Community and national plans and programmes. The National Programme has been made on the basis of the National Policy and the expectations of the international and national legislation specifying it, and is fully adapted to it.

Among the studied EU and national documents, the National Programme has the closest connection with National Environmental Protection Programme IV, and within that, the partial objectives of "Nuclear Safety, Radiation Health" of strategic objective "The Improvement of the Environmental Terms of the Life Quality and Human Health" as well as with document "National Energy Strategy 2030". The objectives of the studied documents are in harmony with the planned measures of the National Programme.

In addition, among the studies related to the set of objectives the National Nuclear Research Programme should be also highlighted, in which the support of the national participation in the international efforts related to the back-end of the fuel cycle and to the research of the new type reactors of 4th generation also directly connects to the objectives of the National Programme.

8.2.2 Major findings of the environmental and sustainability analysis of the National Programme

The principles of the National Programme can be interpreted mostly as the environmental and sustainability aspects serving the protection of the environment, the nature and the human health. (See the principles enlisted in Chapter 1.) Among the environmental aspects, the

priority of the human health and the environment, keeping the radiation exposure at the lowest reasonable level and the principle of minimisation of waste treatment must be highlighted. In addition, the principle of the reduction of the challenges passed to the future generations and of the final disposal of the generated waste within the country must be also highlighted from the aspect of sustainability. The National Programme has been made in accordance with the specified principles, which is constructive from the aspect of the SEA.

8.2.2.1 Assessment according to the environmental impacts

The activities planned by the National Programme involve mostly the operation of already existing facilities and, if necessary, their development and expansion. The SEA evaluated the current condition and the impacts related to the planned measures in detail, by environmental element/system, and radiological and conventional environmental impact. For the purpose of the preparation of the following licensing phases, the SEA specified impact factors and impact processes related to the individual facilities and to the planned activities.

The operation as well as the development/expansion of the existing facilities and the new facility to be implemented in the future, the final disposal facility of high level (and possibly very low level) waste should be implemented so that the radiological impacts do not cause impacts other than neutral ones under normal operating conditions. These are impacts the existence of which can be confirmed (detected for example with very sensitive instruments, or confirmed with measurements and radiation exposure calculations performed during the emission control), but the resulting change of condition of each environmental element or system is so insignificant that these changes cannot be detected. The measuring networks operating at the existing facilities have not detected any deviation from the pre-operation limit-values (so-called baseline) or exceeding the natural background radiation fluctuation in the environmental elements and systems beyond the borders of the site. The distance between the facilities makes sure that no cumulative impacts are expected.

Within the conventional environmental impacts, transport related ones may be significant, irrespective of the fact if materials are supplied for the construction or expansion, or fuel and waste are transported. Air pollution, noise and vibration exposure caused by transports can be reduced by carefully selecting and properly maintaining the delivery roads. The majority of conventional exposures can be well treated with technical devices.The possible dose exposure of the inhabitants during the transportation is insignificant due to the use of equipments designed upon strict regulations.

The expansions and developments planned in the studied Programme do not affect any Natura 2000 area either directly or indirectly. The same applies also to the KKÁT necessary for the new blocks, which will be implemented within the site of the new blocks, according to the plans. Therefore no unfavourable impact is expected in the nature conservation situation of Natura 2000 habitants and species, no Natura 2000 impact assessment is necessary. The same applies to the conditions of waters, the planned measures do not endanger their good ecological conditions specified in the Catchment Area Management Plans, and therefore no analysis pursuant to Section 4.7 of the Water Framework Directive is required.

During the selection of the location of the new depth disposal facility planned to be implemented in the future, radiological safety is the most important aspect, and within this, long-term safety must be guaranteed in the first place. The depth disposal is accompanied also by the establishment of surface facilities, during the land use of which conventional environmental aspects must be also taken into consideration. This can be guaranteed by the mandatory environmental licensing procedure. After the selection of the proper location, the

disposal facility must be designed, established and operated so that no damages are suffered by the environmental values.

The distance of the existing facilities and the potential location of the planned new depth disposal facility under study from the country border makes sure that no significant impact spreading over the country border is expected.

8.2.2.2 Sustainability evaluation

The SEA detailed the general sustainability criteria for this programme. The evaluation of the National Programme for sustainability related efficiency must take into account that the current phase of the National Programme does not contain development decisions on the implementation of new facilities. Typically, it presents the consistency, targets and principles of the planning process, the schedule and theoretical alternatives of the process, using facilities already existing as a result of the planning process to date as a basis. The document is rather a strategy and not a concept from that viewpoint.

Criteria to be followed by the National Programme are summarised by the SEA in the form of a table. In addition, sustainability expectations applicable as planning terms and aspects during further planning of the developments are also included in the table. The experiences related to the existing facilities are favourable from a sustainability aspect, the applied solutions are examples to be followed. The major findings of the evaluation summarised by set of criteria are as follows:

Group of criteria	Expected problems
I Long-term balance must be achieved between meeting human needs and preserving natural and environmental values.	The National Programme does not entail problems difficult to handle from this aspect. No severe problems are expected on this area on the basis of the principles specified at the beginning of the Programme.
II Processes entailing the loss of cardinal values must not be tolerated.	Such problems have not occurred and are not expected to occur.
III The possibility of adaptation to the natural and environmental changes must be provided at individual and social levels	The radioactive waste treatment as an activity and its impacts are neutral from the aspect of the criterion.
IV The possibility of dignified living conditions must be provided for everyone at their domiciles both now and in the future.	Developments made to date confirm that favourable changes are expected from this aspect.
V Only a responsible man is able to achieve a sustainable development.	Based on the experiences, problems may be expected (in view of the deficiencies of the open planning practice observed in certain cases). This can be prevented with correct information supply in due time in the case of the planned facilities.

8.2.2.3 Summary evaluation

Several questions were raised at the beginning of the SEA, during the presentation of the tasks of the assessment and the major methodological aspects. The SEA has set the objective to answer them by the end of the study on the basis of the environmental assessment. The following answers can be given to the questions in brief.

– ***Does the Programme accommodate to the waste hierarchy (prevention; reprocessing; reduction of the volumes and hazard levels of the waste to be disposed)?***

The answer is yes on the basis of the environmental assessment. The accommodation is supported, among others, by the fact that the new fuel cycle introduced in the nuclear power plant reduces the volume of the generated spent fuel; the compaction of the low and intermediate level radioactive solid waste and the use of the liquid waste treatment (LWT) technology reduce the volume of waste to be disposed finally. Such measures include also the safety improving and capacity releasing and increasing activity performed in the KKÁT in Püspökszilágy as well as the introduction of the use of the planned compact waste packages in the NRHT. This may be helped also by the use of the reprocessed fuel in the new blocks.

- ***Are undesirable environmental and sustainability impacts expected? Do (radioactive and conventional) emissions and pollutions affecting the individual environmental elements/systems change, and if so, in what directions?***

  In accordance with Sections 2.2.1 and 2.2.2, no considerable changes are expected from environmental and sustainability aspects.

- ***Is the treatment of potential damage events solved at the proper level?***

  An analysis was made in the documentation supporting the licensing of the individual facilities on the basis of the conservative assumptions related to the radiological consequences of the incident and accident scenarios for both the operating staff and the critical population group. Based on this, no exposure of the critical groups above the permissible level is expected even in the case of such events.

- ***Is safety sustainable and controllable in the long term in the case of the final disposals?***

  No radiation exposure exceeding the specified official limits may affect the operating staff and the critical population group during the normal operation of the facilities or in the case of any conceivable incidents at the existing facilities on the basis of the performed evaluations. The individual facilities are monitored in accordance with the requirements of the Environmental Control and Emission Control Rules approved by the competent authority. The possibility of independent official and civil control is provided in the case of each facility. This latter is performed by associations established in the form of institutions at the existing facilities.

  The long-term radiological calculations were based on a careful calculation process complying with the international practice which was based on the analysis of the characteristics of the disposal system, the features, events and processes. These scenarios were studied also from the aspect of the safety functions of the disposal system on the basis of which a long-term safety model concept could be drawn. According to the long-term evaluations, the safety of the final disposal is guaranteed also in the long term.

- ***Are the liveability of the regions receiving the facilities and the satisfaction of the population expected to change?***

  The practice to date shows that the liveability of the receiving settlements has definitely improved. For example, the development of the municipal infrastructure is spectacular in the case of the NRHT. The acceptance of the operating facilities by the population is supported by the opinion polls. Due to the extensive information supply performed in the vicinity of the operating facilities, the favourable judgement by the affected population may not change. This good practice must be followed also in the case of future developments.

- ***Do the recommended solutions sufficiently reduce the challenges passed to the future generation and promote the enforcement of the "polluter pays" principle?***

The task to avoid challenges more severe than acceptable for the future generations belongs to the principles of the Programme. According to the principles of the Programme, the costs of the treatment of spent fuel and radioactive waste must be borne by those at whom the materials are generated. It also states that the radioactive waste generated in our country must be basically disposed in Hungary finally. Amounts deposited by the Paks Nuclear Power Plant in the Central Nuclear Financial Fund may be allocated only to the financing of tasks related to the treatment of the radioactive waste and the spent fuel as well as to the abandonment of the nuclear facilities, so the principle that this generation may not pass unreasonable challenges to the future generations is met. So the answer to the question is favourable.

- ***Is the protection of the environment and of the human health properly provided within the country and also beyond the country border both now and in the future?***

  Based on the licensing documentation of the individual operating facilities and the results of the continuous environmental control, we can state that the protection of the environment and of the human health is properly provided within the country and also beyond the country border both now and in the future.

8.3 RECOMMENDATIONS

At the end of the assessment, several recommendations to be enforced in the National Programme are given:

- The continuous modernisation of the measuring network of the National Environment Radiation Protection Control System is fundamentally important to allow it to perform environmental controls related to the National Programme in the long term. In addition to the control of the radiological impacts, it is important to regularly (every 8-10 years) assess also the conventional environmental situation at these facilities.
- The completion of environmental works in the planning process of the depth disposal facility is time-consuming. Therefore it is important to start to collect the data within minimum 2 or 3 years, or, if possible, 5 years before the planned acquisition date of the licence.
- 2017 should be a milestone date for the establishment of the legal background necessary for the introduction of the very low level waste category instead of 2020 currently indicated in the National Programme.
- As regards the NRHT, an additional milestone should be included in it, which relates to decision-making on the expansion strategy. (Making of a safety evaluation supporting the decision, based on which the decision on the expansion strategy can be made by the end of 2017 or the beginning of 2018.)

The new facilities mentioned in the National Programme and the planned developments belong to activities subject to environmental impact studies. In this case, the environmental impacts of the facility must be thoroughly studied, and the recommendations for the minimisation of the unfavourable environmental impacts must be specified within the framework of this procedure. The impact process figures indicated in the SAE can serve as a guide in the drawing of the environmental impact studies. In addition to the above recommendations, the SEA specified aspects enforceable in the impact assessments and the planning processes, among others, for delivery schedules, developments of the habitat and ecosystem services.

It would be important for the associations organised around the facilities to use their information channels for the popularisation of the environment-conscious and environment-friendly behaviour and lifestyle. The visitors' centres, the information events and open days arranged in the settlements and the issue of regular publications also allow for it to happen.

List of abbreviations

ADR	European Agreement regarding the International Carriage of D Goods
ALARA	As Low As Reasonable Achievable
NPHMOS	National Public Health and Medical Officer Service
NDGDM, MoI	National Directorate General for Disaster Management of the Ministry of the Inter
BMGE	Budapest University of Technology and Economics
EU	European Union
EU SDS	Review of the EU Sustainable Development Strategy (EU SDS) 10117/06 Coun European Union
LWT	liquid waste treatment
MoA	Ministry of Agriculture:
LLW	long-lasting waste
EIA	environment impact assessment
LILW	low and intermediate level waste
KKÁT	Interim Spent Fuel Storage Facility (Paks)
SNF	spent nuclear fuel
PMO	Prime Minister's Office
HLW	high level waste
IAEA	International Atomic Energy Agency
REUAPH	Renewable Energy Utilisation Action Plan of Hungary 2010-2020
NCCS2	Second National Climate Change Strategy
NSDS	National Sustainable Development Strategy
MND	Ministry for National Development
NEP	National Environmental Protection Programme
NEN	National Ecological Network
NRHT	National Radioactive Waste Disposal Facility (Bátaapáti)
HAEA	Hungarian Atomic Energy Authority
P	Parliament
NWMP	National Waste Management Plan
NIENW	National Inspectorate for Environmental Protection, Nature Conservation a Management,
NERPCS	National Environment Radiation Protection Control System
HMS	Hungarian Meteorological Service
RHFT	Radioactive Waste Treatment and Disposal Facility (Püspökszilágy)
RHK Kft.	Public Limited Company for Radioactive Waste Treatment
SEA	strategic environmental assessment
GHG	greenhouse gases
VLLW	very low level waste

Certificate of eligibility of the experts of Öko Ltd. and Golder Ltd.

LÁSZLÓ TIBOR

ORSZÁGOS KÖRNYEZETVÉDELMI, TERMÉSZETVÉDELMI
ÉS VÍZÜGYI FŐFELÜGYELŐSÉG

Jogi, Termékdíj és Felügyeleti Főosztály
Jogi Osztály

Iktatószám: 14/1781-5/2011.
Ügyintéző: dr. Bordás Ákos
Szakmai ügyintéző: Pataki Boglárka

Tárgy: Szakértői tevékenység engedélyezése élővilágvédelem szakterületére

Nyilvántartási szám: SZ-038/2011.

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Termesztési Kara Táj- és kertépítészeti szak;
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okleveles kertészmérnök

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A névjegyzéki bejegyzés visszavonásig érvényes.

Budapest, 2011. április „ 29 .”

ORSZÁGOS KÖRNYEZETVÉDELMI, TERMÉSZETVÉDELMI ÉS VÍZÜGYI FŐFELÜGYELŐSÉG FŐIGAZGATÓ-HELYETTES

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Tárgy: Továbbképzési kötelezettség teljesítésének igazolása

HATÓSÁGI BIZONYÍTVÁNY

Igazolom, hogy
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Kamarai nyilvántartási szám: **01-7928**
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A továbbképzési kötelezettség teljesítése alapján **a 2019.06.10-ig tartó továbbképzési időszakban** a kérelmezőnek a névjegyzékben a következő jogosultsága szerepel:

SZÉM1 - Közlekedési építmények szakértése

Jelen hatósági bizonyítványt *az építésüggyel összefüggő szakmagyakorlási tevékenységekről szóló 266/2013. (VII. 11.) Korm. rendelet 32. §* és *a közigazgatási hatósági eljárás és szolgáltatás általános szabályairól szóló 2004. évi CXL. törvény 83. §* alapján, a Budapesti és Pest Megyei Mérnöki Kamara által vezetett névjegyzéki nyilvántartás rendelkezésre álló adataiból, valamint a jogosult kérelmére az általa benyújtott továbbképzési igazolások alapján adtam ki.

p. h.

.....
Dr. Ronkay Ferenc
titkár

Kapják:
1. Magyar Emőke
2. Irattár

Budapesti és Pest Megyei Mérnöki Kamara
Telefon: (1) 455-88-60 Fax: (1) 455-88-69
Cím: Budapest IX. kerület 1094 Angyal u. 1-3.
Honlap: http://www.bpmk.hu

Ügyszám: 649/2/01/2014
Ügyintéző neve: Tréfa Judit

Tárgy: Zaj- és rezgésvédelem szakértő tevékenység engedélyezése

HATÁROZAT

Név: **Magyar Emőke**
Lakcím: **1091 Budapest Üllői út 71.**
Végzettségek:
okl. táj- és kertépítészmérnök (száma: 80/1989, kelte: 1989/06/23)
Kamarai nyilvántartási szám: **01-7928**

számára az alábbi tevékenység folytatását engedélyezem, ezzel egyidejűleg a jogosultságot a Magyar Mérnöki Kamara által vezetett névjegyzékbe bejegyzem:

SZKV-1.4. - Zaj- és rezgésvédelem szakértő

Az engedély határozatlan ideig érvényes.

A határozatot *a tervező- és szakértő mérnökök, valamint építészek szakmai kamaráiról szóló 1996. évi LVIII. törvény 42. §-ában* és *a környezetvédelmi, természetvédelmi, vízgazdálkodási és tájvédelmi szakértői tevékenységről szóló 297/2009.(XII.21.) kormányrendeletben* biztosított hatáskörömben hoztam.

A határozat a kérelemnek helyt adott, ezért *a közigazgatási hatósági eljárás és szolgáltatás általános szabályairól szóló 2004. évi CXL. törvény* 72. § (4) bekezdése alapján az indokolást és a jogorvoslatról szóló tájékoztatást mellőztem.

Kelt: 2014. június 10.

p.h.

.....
Dr. Ronkay Ferenc
titkár

Kapják:
1. Magyar Emőke (1091 Budapest Üllői út 71.)
2. Irattár

Budapesti és Pest Megyei Mérnöki Kamara
Telefon: (1) 455-88-60 Fax: (1) 455-88-69
Cím: Budapest IX. kerület 1094 Angyal u. 1-3.
Honlap: http://www.bpmk.hu

Ügyszám: 648/2/01/2014
Ügyintéző neve: Tréfa Judit

Tárgy: Hulladékgazdálkodási szakértő tevékenység engedélyezése

HATÁROZAT

Név: **Magyar Emőke**
Lakcím: **1091 Budapest Üllői út 71.**
Végzettségek:
okl. táj- és kertépítészmérnök (száma: 80/1989, kelte: 1989/06/23)
Kamarai nyilvántartási szám: **01-7928**

számára az alábbi tevékenység folytatását engedélyezem, ezzel egyidejűleg a jogosultságot a Magyar Mérnöki Kamara által vezetett névjegyzékbe bejegyzem:

SZKV-1.1. - Hulladékgazdálkodási szakértő

Az engedély határozatlan ideig érvényes.

A határozatot *a tervező- és szakértő mérnökök, valamint építészek szakmai kamaráiról szóló 1996. évi LVIII. törvény 42. §-ában* és *a környezetvédelmi, természetvédelmi, vízgazdálkodási és tájvédelmi szakértői tevékenységről szóló 297/2009.(XII.21.) kormányrendeletben* biztosított hatáskörömben hoztam.

A határozat a kérelemnek helyt adott, ezért *a közigazgatási hatósági eljárás és szolgáltatás általános szabályairól szóló 2004. évi CXL. törvény* 72. § (4) bekezdése alapján az indokolást és a jogorvoslatról szóló tájékoztatást mellőztem.

Kelt: 2014. június 10.

p.h.

.....
Dr. Ronkay Ferenc
titkár

Kapják:
1. Magyar Emőke (1091 Budapest Üllői út 71.)
2. Irattár

ORSZÁGOS KÖRNYEZETVÉDELMI, TERMÉSZETVÉDELMI
ÉS VÍZÜGYI FŐFELÜGYELŐSÉG

Jogi, Közigazgatási és Koordinációs Főosztály
Jogi és Koordinációs Osztály

Ügyiratszám: 14/5563-2/2009.
Előadó: dr. Zöllner Polett

Sz-033/2009.

HATÁROZAT

Magyar Emőke (lakik: 1091 Budapest, Üllői út 71.) kérelmezőt, aki

született 1965. május 18-án, Budapesten;

anyja neve: Bozóki Erika;

diplomájának (oklevelének) kiállítója, száma, kelte:

Kertészeti és Élelmiszeripari Egyetem
Termesztési Kar, 80/1989., 1989. június 23.;

szakképzettségei:

okl. táj- és kertépítészmérnök

SZTV élővilágvédelem
SZTjV tájvédelem

szakterületeken a 378/2007. (XII. 23.) Korm. rendelet 6. § (1) bekezdése alapján a természetvédelmi, tájvédelmi szakértők névjegyzékébe bejegyeztem.

A névjegyzéki bejegyzés visszavonásig érvényes.

Budapest, 2009. szeptember 7.

Dr. Hecsei Pál
főigazgató-helyettes

NAGY ISTVÁN

BUDAPESTI ÉS PEST MEGYEI MÉRNÖKI KAMARA
1094 Budapest, Angyal u. 1-3.
Telefon: 455-8860, fax: 455-8869, honlap: www.bpmk.hu

Határozat száma: 4118/2010 Ügyintézőnk: Hujbert-Bíró Olga

Az 1996. évi LVIII. törvény, illetve a 244/2006. (XII. 5.) Korm. rend. felhatalmazása alapján, a Budapesti és Pest Megyei Mérnöki Kamara az Ön jogosultság iránti kérelmét elbírálta, és az alábbi határozatot hozta:

HATÁROZAT

A 24/1971. (VI. 8.), a 104/2006. (IV. 8.), a 244/2006. (XII. 5.) és a 378/2007. (XII. 23.) Korm. rendelet, valamint a miniszteri rendeletek felhatalmazása, és a Magyar Mérnöki Kamara Jogosultság Elbírálási Szabályzata előírásainak megfelelően

Nagy István részére, akinek

mérnöki kamarai nyilvántartási száma: **01-1361**
születési helye: **Csátalja**, ideje: **1958. 09. 21.**, anyja neve: **Kelemen Ilona**
lakcíme: **1098 Budapest, Távíró utca 15. 2. lh. II/11.**

oklevél: **építőmérnök,** száma: **119/1982**, kelte: **1982. 07. 10.**
kiállítója: **Ybl Miklós Építőipari Műszaki Főiskola**
oklevél: **vízépítési szakmérnök,** száma: **É-01/19-1987**, kelte: **1987. 02. 20.**
kiállítója: **Ybl Miklós Építőipari Műszaki Főiskola**
oklevél: **okl. építőmérnök,** száma: **10/1995**, kelte: **1995. 06. 30.**
kiállítója: **BME Építőmérnöki Kar Vízépítőmérnöki Szak**

ENGEDÉLYEZI a(z)

VZ-T	**kamarai kóddal jelzett**	**Vízimérnöki tervezést**
SZÉM 3.	**kamarai kóddal jelzett**	**Vízügyi szakértést**
SZÉM 8.	**kamarai kóddal jelzett**	**Környezetvédelmi szakértést**
SZKV-1.1.	**kamarai kóddal jelzett**	**Hulladékgazdálkodási szakértő szakértést**
SZKV-1.3.	**kamarai kóddal jelzett**	**Víz- és földtani közeg védelem szakértést**
SZVV-3.1.	**kamarai kóddal jelzett**	**Hidrológiai, vízgyűjtő-gazdálkodás, vízkészlet-gazdálkodás, nagytérségi vízgazdálkodási rendszerek szakértést**
SZVV-3.2.	**kamarai kóddal jelzett**	**Ivó- és ipari vízellátás, szennyvízelvezetési célú csatornázás szakértést**
SZVV-3.5.	**kamarai kóddal jelzett**	**Árvízmentesítés, árvízvédelem, folyó- és tószabályozás, sík- és dombvidéki vízrendezés, belvízvédelem, öntözés szakértést**
SZVV-3.4.	**kamarai kóddal jelzett**	**Szennyvíztisztítás szakértést**
SZVV-3.10.	**kamarai kóddal jelzett**	**Vízanalitika, vízminőség-védelem, vízminőségi kárelhárítás szakértést**
SZB	**kamarai kóddal jelzett**	**Beruházás szakértést**

Az engedély megújítási/továbbképzési határideje: 2015. 12. 21., de az engedélyezett tevékenységet csak akkor végezheti, ha a Magyar Mérnöki Kamara által vezetett – az adott időszakra hatályos – országos Névjegyzékében szerepel. A képzettségének megfelelő szakterületen rendelkezik illetékességgel, ezt nem lépheti túl; e tekintetben is be kell tartania a Magyar Mérnöki Kamara Etikai-fegyelmi Kódexében megfogalmazottakat. Amennyiben jogszabály a jelen engedély mellett, további követelményt (pl. vizsgát, továbbképzést, stb.) is előír, akkor kérelmező feladata, hogy ennek is eleget tegyen.

INDOKLÁS

A kérelmező igazolta, hogy a hivatkozott jogszabályban a jogosultság megadásához meghatározott követelményeket kielégítette, így az engedély fenti feltételekkel megadható.

Budapest, 2010. 12. 21.

Kassai Ferenc
(elnök)

Dr. Ronkay Ferenc
(titkár)

ORSZÁGOS KÖRNYEZETVÉDELMI, TERMÉSZETVÉDELMI
ÉS VÍZÜGYI FŐFELÜGYELŐSÉG

Jogi, Termékdíj és Felügyeleti Főosztály
Jogi Osztály

SZ-100/2010.

Iktatószám: 14/6582/2/2010.
Ügyintéző: Dr. Pozsonyi Katalin

Tárgy: Természetvédelmi és tájvédelmi szakértői névjegyzékbe történő felvételi kérelem elbírálása

HATÁROZAT

HITELESÍTÉS A
FÜLÖP ÁLDÁS

Nagy István (lakcím: 1098 Budapest, Távíró u.15. 2/11.) kérelmezőt, aki

született: Csátalja, 1958. szeptember 21.

anyja neve: Kelemen Ilona

diplomájának (oklevelének) kiállítója, száma, kelte:

1. Pollack Mihály Műszaki Főiskola
   É-01/19-1987 Baja, 1987. február 20.
2. Budapesti Műszaki Egyetem Építőmérnöki Kar Vízépítő Szak
   10/1995., Budapest, június 30.
3. Budapesti Műszaki Egyetem Természet- és Társadalomtudományi Kar
   4/1995. Budapest, 1995. október 30.

szakképzettsége:

okleveles vízépítési szaküzemmérnök, okleveles építőmérnök, környezeti menedzser mérnök

SZTjV **Tájvédelem**

szakterületen a 297/2009. (XII. 21.) Korm. rendelet 9. § (1) bekezdése alapján nyilvántartásba vettem, számára a szakértői tevékenységet engedélyezem.

A névjegyzéki bejegyzés visszavonásig érvényes.

Budapest, 2010. december „ 20 . "

ORSZÁGOS KÖRNYEZETVÉDELMI, TERMÉSZETVÉDELMI ÉS VÍZÜGYI FŐFELÜGYELŐSÉG 4.

Dr. Hecsei Pál
Főigazgató-helyettes

Kapják:
1) Nagy István (1098 Budapest, Távíró u.15. 2/11.)
2) Gazdasági Főosztály (helyben)
3) Irattár (helyben)

PUSKÁS ERIKA

BUDAPESTI ÉS PEST MEGYEI MÉRNÖKI KAMARA
1094 Budapest, Angyal u. 1-3.
Telefon: 455-8860, fax: 455-8869, honlap: www.bpmk.hu

Határozat száma: 4116/2010 Ügyintézőnk: Hujbert-Bíró Olga

Az 1996. évi LVIII. törvény, illetve a 244/2006. (XII. 5.) Korm. rend. felhatalmazása alapján, a Budapesti és Pest Megyei Mérnöki Kamara az Ön jogosultság iránti kérelmét elbírálta, és az alábbi határozatot hozta:

HATÁROZAT

A 24/1971. (VI. 8.), a 104/2006. (IV. 8.), a 244/2006. (XII. 5.) és a 378/2007. (XII. 23.) Korm. rendelet, valamint a miniszteri rendeletek felhatalmazása, és a Magyar Mérnöki Kamara Jogosultság Elbírálási Szabályzata előírásainak megfelelően

Puskás Erika részére, akinek

mérnöki kamarai nyilvántartási száma: **01-13805**
születési helye: **Békés**, ideje: **1976. 09. 06.**, anyja neve: **Wagner Erika**
lakcíme: **1115 Budapest, Bánk bán utca 9. II/12.**

oklevél: **környezetmérnök,** száma: **53/1998**, kelte: **1998. 06. 25.**
kiállítója: **Janus Pannonius Tudományegyetem Pollack Mihály Műszaki Főiskolai Kar**
oklevél: **okl. biomérnök,** száma: **88/2001**, kelte: **2001. 06. 19.**
kiállítója: **Budapesti Műszaki és Gazdaságtudományi Egyetem Vegyészmérnöki Kar**

ENGEDÉLYEZI a(z)

KB-T	**kamarai kóddal jelzett**	**Környezetmérnöki (létesítményi és technológiai) tervezést**
SZKV-1.1.	**kamarai kóddal jelzett**	**Hulladékgazdálkodási szakértő szakértést**
SZKV-1.2.	**kamarai kóddal jelzett**	**Levegőtisztaság-védelem szakértő szakértést**
SZKV-1.3.	**kamarai kóddal jelzett**	**Víz- és földtani közeg védelem szakértést**
SZKV-1.4.	**kamarai kóddal jelzett**	**Zaj- és rezgésvédelem szakértő szakértést**
SZB	**kamarai kóddal jelzett**	**Beruházás szakértést**

Az engedély megújítási/továbbképzési határideje: 2016. 04. 12., de az engedélyezett tevékenységet csak akkor végezheti, ha a Magyar Mérnöki Kamara által vezetett – az adott időszakra hatályos – országos Névjegyzékében szerepel. A képzettségének megfelelő szakterületen rendelkezik illetékességgel, ezt nem lépheti túl; e tekintetben is be kell tartania a Magyar Mérnöki Kamara Etikai-fegyelmi Kódexében megfogalmazottakat. Amennyiben jogszabály a jelen engedély mellett, további követelményt (pl. vizsgát, továbbképzést, stb.) is előír, akkor kérelmező feladata, hogy ennek is eleget tegyen.

INDOKLÁS

A kérelmező igazolta, hogy a hivatkozott jogszabályban a jogosultság megadásához meghatározott követelményeket kielégítette, így az engedély fenti feltételekkel megadható.

Budapest, 2011. 04. 12.

Kassai Ferenc
(elnök)

Dr. Ronkay Ferenc
(titkár)

Kapják: 1. címzett, 2. irattár

HITELESÍTÉS A TÁLON BELÜL

ORSZÁGOS KÖRNYEZETVÉDELMI, TERMÉSZETVÉDELMI
ÉS VÍZÜGYI FŐFELÜGYELŐSÉG

Jogi, Termékdíj és Felügyeleti Főosztály
Jogi Osztály

HITELESÍTÉS A TÚLOLDALON

Iktatószám: 14/5393-2/2010.
Ügyintéző: dr. Zöllner Polett

SZ-077/2010.

HATÁROZAT

Puskás Erika (lakik: 1115 Budapest, Bánk bán u. 9., 2. em. 12.) kérelmezőt, aki

született: Békés, 1976. szeptember 6.;

anyja neve: Wagner Erika;

diplomáinak (okleveleinek) kiállítója, száma, kelte:

1. Janus Pannonius Tudományegyetem;
   Pollack Mihály Műszaki Főiskolai Kar;
   53/1998.; 1998. június 25.
2. Budapesti Műszaki és Gazdaságtudományi Egyetem;
   Vegyészmérnöki Kar;
   88/2001.; 2001. június 19.

szakképzettsége:

környezetmérnök;
okleveles biomérnök

SZTV **élővilágvédelem**

szakterületen a 297/2009. (XII. 21.) Korm. rendelet 9. § (1) bekezdése alapján nyilvántartásba vettem, számára a szakértői tevékenységet engedélyezem.

A névjegyzéki bejegyzés visszavonásig érvényes.

Budapest, 2010. szeptember „24."

Dr. Hecsei Pál
főigazgató-helyettes

SCHEER MÁRTA

ORSZÁGOS KÖRNYEZETVÉDELMI, TERMÉSZETVÉDELMI
ÉS VÍZÜGYI FŐFELÜGYELŐSÉG

Jogi, Termékdíj és Felügyeleti Főosztály
Jogi Osztály

Iktatószám: 14/05396-4/2010. SZ-089/2010.
Ügyintéző: dr. Horváth Katalin
Szakmai előadó: Csikai Csaba

HITELESÍTÉS
TÚLOLDALON

HATÁROZAT

Scheer Márta (lakik: 2086 Tinnye, Ady Endre u. 715. hrsz.) kérelmezőt, aki

született: Budapest, 1959. december 8.;

anyja neve: Horváth Emma;

diplomájának (oklevelének) kiállítója, száma, kelte:

Eötvös Loránd Tudományegyetem;
Természettudományi Kar;
735/1983.; 1983. július 15.;

szakképzettsége:

okleveles biológia-földrajz szakos középiskolai tanár

SZTV **élővilágvédelem**

szakterületen a 297/2009. (XII. 21.) Korm. rendelet 9. § (1) bekezdése alapján nyilvántartásba vettem, számára a szakértői tevékenységet engedélyezem.

A névjegyzéki bejegyzés visszavonásig érvényes.

Budapest, 2010. november „09.”

ORSZÁGOS KÖRNYEZETVÉDELMI, TERMÉSZETVÉDELMI ÉS VÍZÜGYI FŐFELÜGYELŐSÉG 4.

Dr. Hecsei Pál
főigazgató-helyettes

SZŐKE NORBERT

ORSZÁGOS KÖRNYEZETVÉDELMI, TERMÉSZETVÉDELMI
ÉS VÍZÜGYI FŐFELÜGYELŐSÉG

SZ-078/2010.

Iktatószám: 14/05395-2/2010. *Tárgy:* Természetvédelmi és tájvédelmi szakértői névjegyzékbe történő felvételi kérelem elbírálása

HATÁROZAT

Szőke Norbert (lakcím: 1094 Budapest, Viola u. 43. I. em. 2.) kérelmezőt, aki

született: Kiskunhalas, 1977. szeptember 9;

anyja neve: Tóth Ágnes,

diplomáinak (okleveleinek) kiállítója, száma, kelte:

1. Szegedi Tudományegyetem
   Természettudományi Kar
   43/2004; 2004. május 12.

szakképzettsége:

okleveles környezetkutató geográfus

SZTV	**Földtani természeti értékek és barlangok védelme**
SZTjV	**Tájvédelem**

szakterületen a 297/2009. (XII. 21.) Korm. rendelet 9. § (1) bekezdése alapján nyilvántartásba vettem, számára a szakértői tevékenységet engedélyezem.

A névjegyzéki bejegyzés visszavonásig érvényes.

Budapest, 2010. november „22 „

ORSZÁGOS KÖRNYEZETVÉDELMI, TERMÉSZETVÉDELMI ÉS VÍZÜGYI FŐFELÜGYELŐSÉG 4.

Dr. Hecsei Pál
Főigazgató-helyettes

Kapják:
1) Szőke Norbert (1094 Budapest, Viola u. 43. I. em. 2.)
2) Gazdasági Főosztály (helyben)
3) Irattár (helyben)

VIDÉKI BIANKA

BUDAPESTI ÉS PEST MEGYEI MÉRNÖKI KAMARA
1094 Budapest, Angyal u. 1-3.
Telefon: 455-8860, fax: 455-8869, honlap: www.bpmk.hu

Határozat száma: 2562/2012 Ügyintézőnk: Hujbert-Bíró Olga

Az 1996. évi LVIII. törvény, illetve a 244/2006. (XII. 5.) Korm. rend. felhatalmazása alapján, a Budapesti és Pest Megyei Mérnöki Kamara az Ön jogosultság iránti kérelmét elbírálta, és az alábbi határozatot hozta:

HATÁROZAT

A 24/1971. (VI. 8.), a 104/2006. (IV. 8.), a 244/2006. (XII. 5.) és a 378/2007. (XII. 23.) Korm. rendelet, valamint a miniszteri rendeletek felhatalmazása, és a Magyar Mérnöki Kamara Jogosultság Elbírálási Szabályzata előírásainak megfelelően

Vidéki Bianka részére, akinek

mérnöki kamarai nyilvántartási száma: **01-14461**
születési helye: **Budapest**, ideje: **1978. 12. 21.**, anyja neve: **Reményi Judit**
lakcíme: **1115 Budapest, Fraknó u. 24/A. VI/20.**

oklevél: **okl.biomérnök,** száma: **22/2003**, kelte: **2003. 02. 13.**
kiállítója: **BME Vegyészmérnöki Kar**
oklevél: **környezetirányítási szakértő,** száma: **4122**, kelte: **2006. 06. 13.**
kiállítója: **BME Gazdasági és Társadalomtudományi Kar**
oklevél: **környezetvédelmi szakmérnök,** száma: **6027**, kelte: **2010. 04. 28.**
kiállítója: **BME Vegyészmérnöki Kar**

ENGEDÉLYEZI a(z)

SZKV-1.1.	**kamarai kóddal jelzett**	**Hulladékgazdálkodási szakértő szakértést**
SZKV-1.2.	**kamarai kóddal jelzett**	**Levegőtisztaság-védelem szakértő szakértést**
SZKV-1.3.	**kamarai kóddal jelzett**	**Víz- és földtani közeg védelem szakértést**
SZKV-1.4.	**kamarai kóddal jelzett**	**Zaj- és rezgésvédelem szakértő szakértést**

Az engedély megújítási/továbbképzési határideje: 2017. 08. 21., de az engedélyezett tevékenységet csak akkor végezheti, ha a Magyar Mérnöki Kamara által vezetett – az adott időszakra hatályos – országos Névjegyzékében szerepel. A képzettségének megfelelő szakterületen rendelkezik illetékességgel, ezt nem lépheti túl; e tekintetben is be kell tartania a Magyar Mérnöki Kamara Etikai-fegyelmi Kódexében megfogalmazottakat. Amennyiben jogszabály a jelen engedély mellett, további követelményt (pl. vizsgát, továbbképzést, stb.) is előír, akkor kérelmező feladata, hogy ennek is eleget tegyen.

INDOKLÁS

A kérelmező igazolta, hogy a hivatkozott jogszabályban a jogosultság megadásához meghatározott követelményeket kielégítette, így az engedély fenti feltételekkel megadható.

Budapest, 2012. 08. 21.

Kassai Ferenc
(elnök)

Dr. Ronkay Ferenc
(titkár)

BUDAPESTI és PEST MEGYEI MÉRNÖKI KAMARA 1094 Bp., Angyal u. 1-3. * 7. *

Kapják: 1. címzett, 2. irattár

ORSZÁGOS KÖRNYEZETVÉDELMI ÉS
TERMÉSZETVÉDELMI FŐFELÜGYELŐSÉG

Iktatószám: 14/05116-5/2014. *Tárgy:* szakértői tevékenység engedélyezése
Ügyintéző: Dr. Schimek Szilvia
Kellner Szilárd *Nyilvántartási szám:* Sz-067/2014.

H A T Á R O Z A T

Megállapítom, hogy **Vidéki Bianka Judit** (1115 Budapest, Fraknó u. 24/A. VI/20.)

született: 1978. december 21.

anyja neve: Reményi Judit Eszter

szakirányú végzettsége:

1. A Budapesti Műszaki és Gazdaságtudományi Egyetem Vegyészmérnöki Kar Biomérnöki Szak 22/2003. számú, 2003. február 13. napján kelt oklevele alapján **okleveles biomérnök**

a környezet védelmének általános szabályairól szóló 1995. évi LIII. törvény (a továbbiakban: ***Kvt.***) 92. §-ában, és *a környezetvédelmi, természetvédelmi, vízgazdálkodási és tájvédelmi szakértői tevékenységről* szóló 297/2009. (XII. 21.) Korm. rendeletben meghatározott feltételeknek megfelel, ezért kérelmére

SZTV Élővilágvédelem

szakterületen szakértői tevékenység végzését a Kvt. 92. § (2) bekezdés a) pontja alapján engedélyezem, és a Kvt. 92. § (4) bekezdése alapján a természetvédelmi szakértői névjegyzékbe felveszem.

Jelen engedély visszavonásig érvényes.

Jelen egyszerűsített határozat *a közigazgatási hatósági eljárás és szolgáltatás általános szabályairól* szóló 2004. évi CXL. törvény 72. §-ának (4) bekezdése alapján nem tartalmazza az indokolást és a jogorvoslatról szóló tájékoztatást.

Budapest, 2014. november 19.

A kiadmány hiteléül

Búsi Lajos
főigazgató megbízásából

Dr. Szentmiklóssy Zoltán s.k.
főosztályvezető

KUNFALVI VIKTOR

Budapesti és Pest Megyei Mérnöki Kamara

Telefon: (1) 455-88-60 Fax: (1) 455-88-69
Cím: Budapest IX. kerület 1094 Angyal u. 1-3.
Honlap: http://www.bpmk.hu

Ügyszám: 01-1063/2014 **Kelt:** 2014. szeptember 9.
Ügyintéző neve: Tréfa Judit
Tárgy: Továbbképzési kötelezettség teljesítésének igazolása

HATÓSÁGI BIZONYÍTVÁNY

Igazolom, hogy
Név: **Kunfalvi Viktor**
Lakcím: **2030 Érd Pál u. 18.**
Kamarai nyilvántartási szám: **13-7834**
Végzettségek:
vegyészmérnök (száma: 130/1978, kelte: 1978/07/20)
környezetvédelmi szakmérnök (száma: 33/1999, kelte: 1999/04/13)

az építésügyi és az építésüggyel összefüggő szakmagyakorlási tevékenységekről szóló 266/2013. (VII. 11.) Korm. rendelet szerinti továbbképzési kötelezettségének eleget tett.
A továbbképzési kötelezettség teljesítése alapján **a 2019.09.09-ig tartó továbbképzési időszakban** a kérelmezőnek a névjegyzékben a következő jogosultsága szerepel:

SZÉM3 - Vízgazdálkodási építmények szakértése

Jelen hatósági bizonyítványt *az építésüggyel összefüggő szakmagyakorlási tevékenységekről szóló 266/2013. (VII. 11.) Korm. rendelet 32. §* és *a közigazgatási hatósági eljárás és szolgáltatás általános szabályairól szóló 2004. évi CXL. törvény 83. §* alapján, a Budapesti és Pest Megyei Mérnöki Kamara által vezetett névjegyzéki nyilvántartás rendelkezésre álló adataiból, valamint a jogosult kérelmére az általa benyújtott továbbképzési igazolások alapján adtam ki.

.....
Dr. Ronkay Ferenc
titkár

p. h.

BUDAPESTI ÉS PEST MEGYEI MÉRNÖKI KAMARA 1094 Bp., Angyal u. 1-3. * 6. *

Kapják:
1. Kunfalvi Viktor
2. Irattár

Budapesti és Pest Megyei Mérnöki Kamara
Telefon: (1) 455-88-60 Fax: (1) 455-88-69
Cím: Budapest IX. kerület 1094 Angyal u. 1-3.
Honlap: http://www.bpmk.hu

Ügyszám: 1218/2/01/2014
Ügyintéző neve: Tréfa Judit

Tárgy: Vízanalitika, vízminőség-védelem, vízminőségi kárelhárítás tevékenység engedélyezése

HATÁROZAT

Név: **Kunfalvi Viktor**
Lakcím: **2030 Érd Pál u. 18.**
Végzettségek:
vegyészmérnök (száma: 130/1978, kelte: 1978/07/20)
környezetvédelmi szakmérnök (száma: 33/1999, kelte: 1999/04/13)
Kamarai nyilvántartási szám: **13-7834**

számára az alábbi tevékenység folytatását engedélyezem, ezzel egyidejűleg a jogosultságot a Magyar Mérnöki Kamara által vezetett névjegyzékbe bejegyzem:

SZVV-3.10. - Vízanalitika, vízminőség-védelem, vízminőségi kárelhárítás

Az engedély határozatlan ideig érvényes.

A határozatot *a tervező- és szakértő mérnökök, valamint építészek szakmai kamaráiról szóló 1996. évi LVIII. törvény 42. §-ában* és *a környezetvédelmi, természetvédelmi, vízgazdálkodási és tájvédelmi szakértői tevékenységről szóló 297/2009.(XII.21.) kormányrendeletben* biztosított hatáskörömben hoztam.

A határozat a kérelemnek helyt adott, ezért *a közigazgatási hatósági eljárás és szolgáltatás általános szabályairól szóló 2004. évi CXL. törvény* 72. § (4) bekezdése alapján az indokolást és a jogorvoslatról szóló tájékoztatást mellőztem.

Kelt: 2014. szeptember 9.

.....
Dr. Ronkay Ferenc
titkár

p.h.

BUDAPEST ÉS PEST MEGYEI MÉRNÖKI KAMARA 1094 Bp., Angyal u. 1-3. * 6. *

Kapják:
1. Kunfalvi Viktor (2030 Érd Pál u. 18.)
2. Irattár

Budapesti és Pest Megyei Mérnöki Kamara
Telefon: (1) 455-88-60 Fax: (1) 455-88-69
Cím: Budapest IX. kerület 1094 Angyal u. 1-3.
Honlap: http://www.bpmk.hu

Ügyszám: 1215/2/01/2014
Ügyintéző neve: Tréfa Judit

Tárgy: Hulladékgazdálkodási szakértő tevékenység engedélyezése

HATÁROZAT

Név: **Kunfalvi Viktor**
Lakcím: **2030 Érd Pál u. 18.**
Végzettségek:
vegyészmérnök (száma: 130/1978, kelte: 1978/07/20)
környezetvédelmi szakmérnök (száma: 33/1999, kelte: 1999/04/13)
Kamarai nyilvántartási szám: **13-7834**

számára az alábbi tevékenység folytatását engedélyezem, ezzel egyidejűleg a jogosultságot a Magyar Mérnöki Kamara által vezetett névjegyzékbe bejegyzem:

SZKV-1.1. - Hulladékgazdálkodási szakértő

Az engedély határozatlan ideig érvényes.

A határozatot *a tervező- és szakértő mérnökök, valamint építészek szakmai kamaráiról szóló 1996. évi LVIII. törvény 42. §-ában* és *a környezetvédelmi, természetvédelmi, vízgazdálkodási és tájvédelmi szakértői tevékenységről szóló 297/2009.(XII.21.) kormányrendeletben* biztosított hatáskörömben hoztam.

A határozat a kérelemnek helyt adott, ezért *a közigazgatási hatósági eljárás és szolgáltatás általános szabályairól szóló 2004. évi CXL. törvény* 72. § (4) bekezdése alapján az indokolást és a jogorvoslatról szóló tájékoztatást mellőztem.

Kelt: 2014. szeptember 9.

p.h.

BUDAPESTI és PEST MEGYEI MÉRNÖKI KAMARA 1094 Bp., Angyal u. 1-3. * 6. *

.....
Dr. Ronkay Ferenc
titkár

Kapják:
1. Kunfalvi Viktor (2030 Érd Pál u. 18.)
2. Irattár

Budapesti és Pest Megyei Mérnöki Kamara
Telefon: (1) 455-88-60 Fax: (1) 455-88-69
Cím: Budapest IX. kerület 1094 Angyal u. 1-3.
Honlap: http://www.bpmk.hu

Ügyszám: 1216/2/01/2014
Ügyintéző neve: Tréfa Judit

Tárgy: Levegőtisztaság-védelem szakértő tevékenység engedélyezése

HATÁROZAT

Név: **Kunfalvi Viktor**
Lakcím: **2030 Érd Pál u. 18.**
Végzettségek:
vegyészmérnök (száma: 130/1978, kelte: 1978/07/20)
környezetvédelmi szakmérnök (száma: 33/1999, kelte: 1999/04/13)
Kamarai nyilvántartási szám: **13-7834**

számára az alábbi tevékenység folytatását engedélyezem, ezzel egyidejűleg a jogosultságot a Magyar Mérnöki Kamara által vezetett névjegyzékbe bejegyzem:

SZKV-1.2. - Levegőtisztaság-védelem szakértő

Az engedély határozatlan ideig érvényes.

A határozatot *a tervező- és szakértő mérnökök, valamint építészek szakmai kamaráiról szóló 1996. évi LVIII. törvény 42. §-ában* és *a környezetvédelmi, természetvédelmi, vízgazdálkodási és tájvédelmi szakértői tevékenységről szóló 297/2009.(XII.21.) kormányrendeletben* biztosított hatáskörömben hoztam.

A határozat a kérelemnek helyt adott, ezért *a közigazgatási hatósági eljárás és szolgáltatás általános szabályairól szóló 2004. évi CXL. törvény* 72. § (4) bekezdése alapján az indokolást és a jogorvoslatról szóló tájékoztatást mellőztem.

Kelt: 2014. szeptember 9.

.....
Dr. Ronkay Ferenc
titkár

p.h.

Kapják:
1. Kunfalvi Viktor (2030 Érd Pál u. 18.)
2. Irattár

Budapesti és Pest Megyei Mérnöki Kamara
Telefon: (1) 455-88-60 Fax: (1) 455-88-69
Cím: Budapest IX. kerület 1094 Angyal u. 1-3.
Honlap: http://www.bpmk.hu

Ügyszám: 1217/2/01/2014
Ügyintéző neve: Tréfa Judit

Tárgy: Víz- és földtani közeg védelem szakértő tevékenység engedélyezése

HATÁROZAT

Név: **Kunfalvi Viktor**
Lakcím: **2030 Érd Pál u. 18.**
Végzettségek:
vegyészmérnök (száma: 130/1978, kelte: 1978/07/20)
környezetvédelmi szakmérnök (száma: 33/1999, kelte: 1999/04/13)
Kamarai nyilvántartási szám: **13-7834**

számára az alábbi tevékenység folytatását engedélyezem, ezzel egyidejűleg a jogosultságot a Magyar Mérnöki Kamara által vezetett névjegyzékbe bejegyzem:

SZKV-1.3. - Víz- és földtani közeg védelem szakértő

Az engedély határozatlan ideig érvényes.

A határozatot *a tervező- és szakértő mérnökök, valamint építészek szakmai kamaráiról szóló 1996. évi LVIII. törvény 42. §-ában* és *a környezetvédelmi, természetvédelmi, vízgazdálkodási és tájvédelmi szakértői tevékenységről szóló 297/2009.(XII.21.) kormányrendeletben* biztosított hatáskörömben hoztam.

A határozat a kérelemnek helyt adott, ezért *a közigazgatási hatósági eljárás és szolgáltatás általános szabályairól szóló 2004. évi CXL. törvény* 72. § (4) bekezdése alapján az indokolást és a jogorvoslatról szóló tájékoztatást mellőztem.

Kelt: 2014. szeptember 9.

BUDAPESTI és PEST MEGYEI MÉRNÖKI KAMARA 1094 Bp., Angyal u. 1-3.
p.h.

.....
Dr. Ronkay Ferenc
titkár

Kapják:
1. Kunfalvi Viktor (2030 Érd Pál u. 18.)
2. Irattár