RADIOACTIVE WASTE MANAGEMENT PROGRAMMES IN OECD/NEA MEMBER COUNTRIES

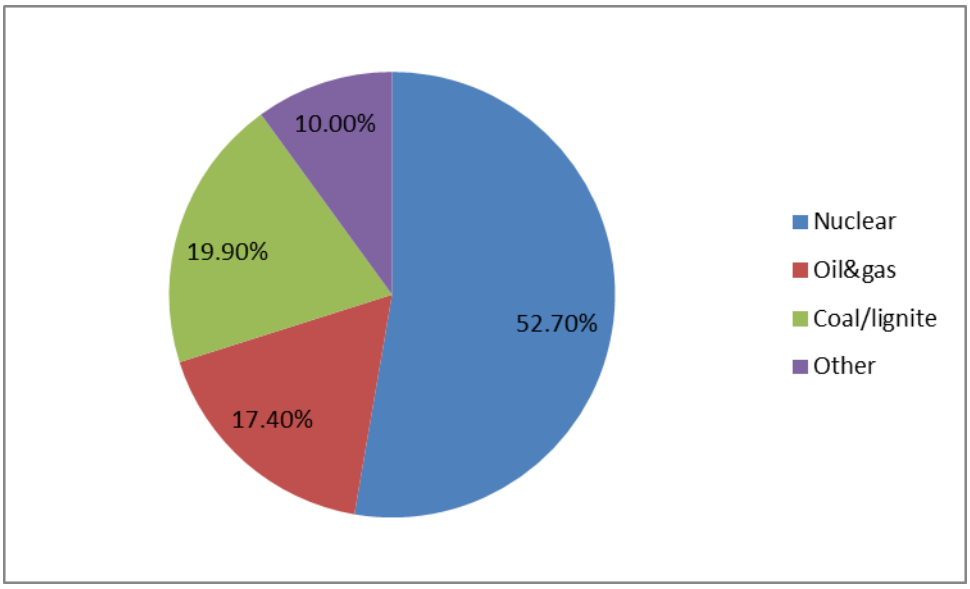
HUNGARY

NATIONAL NUCLEAR ENERGY CONTEXT

Commercial utilisation of nuclear power in Hungary goes back to several decades. The four VVER 440/213 nuclear units of the Paks Nuclear Power Plant were connected to the electricity grid between 1983 and 1987. In 2015 the NPP generated 15.8 TWh of electricity which accounted for 52.7% of the total electricity generated in that year in Hungary. These data are characteristic for the period of time around 2015.

In January 2014 the Government of Hungary and the Government of the Russian Federation concluded an agreement on the cooperation in the field of peaceful use of nuclear energy, which was promulgated in the Act II of 2014. Among others, the Agreement includes the cooperation on the establishment of two VVER-1200 type nuclear power plant units at the Paks site, to be commissioned in 2025, and 2026 respectively. The present country profile of Hungary does not cover the spent fuel and radioactive waste management issues of the new units.

Components of Domestic Electricity Production 2015



Source: MAVIR Hungarian Independent Transmission Operator Company Ltd.

SOURCES, TYPES AND QUANTITIES OF WASTE

Waste classification

Most of the radioactive waste in Hungary originates from the operation of the Paks NPP, and much smaller quantities are generated by other (rather institutional, non-NPP) users of radioactive isotopes.

The following classification scheme is based on Appendix 2 in the Decree 47/2003 (VIII. 8.) of the Minister of Health on certain issues of interim storage and final disposal of radioactive wastes, and on certain radiohygiene issues of naturally occurring radioactive materials concentrated during industrial activity.

General classification of radioactive waste

1. Radioactive waste is classified as being low and intermediate level where the waste's heat production during disposal and storage is negligible.
   a) Low- and intermediate-level radioactive waste (LLW/ILW) is short-lived where the half-life of the radionuclides is 30 years or less. Short-lived ILW contains long-lived alpha emitter radionuclides only in limited concentration (this concentration is 4000 Bq/g in the case of collecting packaging, and 400 Bq/g on average for the whole quantity of waste).
   b) Low- and intermediate-level radioactive waste is long-lived where the half-life of the radionuclides and/or the concentration of the alpha emitter radionuclides exceeds the limits for short-lived radioactive waste.
2. High-level radioactive waste is waste where the heat production is so significant (above 2 kW/m^3) that it has to be considered during the design and operation of storage and disposal options.
3. Within the above classifications the authority can prescribe more detailed classifications for low, intermediate and high level radioactive wastes.

Classification for low- and intermediate-level radioactive waste:

1. The classification of the radioactive waste into low- and intermediate-level classes shall be performed based on the activity-concentration (AC) and exemption activity-concentration (EAC) of the radioisotope contained in it. For low-level wastes the activity concentration is between 1 EAC and 10^3 EAC.
2. If the radioactive waste contains more radioisotopes, the classification shall take into account all radioisotopes. In that case for low level wastes the sum of the AC/EAC values for all the radioisotopes shall be under 10^3.

Waste sources

Inventory and rate of generation of HLW from NPP operation and decommissioning

HLW is generated primarily by the Paks NPP, and only in relatively small quantities. At present, there is no decision on the back-end of the fuel cycle, the final form of HLW (spent fuel or the highly active residue arising from reprocessing) is not known. Spent fuel is stored

for the time being in spent fuel ponds in the reactor buildings and in the Spent Fuel Interim Storage Facility. The rate of generation of HLW from routine operations is about 5 m^3/year, which will result in a total of about 210 m^3 by the end of NPP operation. The amount of HLW from decommissioning of the Paks NPP is currently estimated to be about 70 m^3.

Inventory and rate of generation of LLW/ILW from NPP operation and decommissioning

The amount of solid LLW/ILW produced at the Paks NPP is now estimated at 180 m^3/year, after compaction. The rate of generation of liquid radioactive waste is about 280 m^3/year in total for the four reactor units. The total volume of LLW/ILW generated during the operation of Paks NPP will be about 15 900 m^3.

The disposal capacity required for LLW/ILW from the decommissioning of the Paks NPP has recently been estimated to be about 26 700 m^3. This amount includes also VLLW (very low level waste), a category of waste to be introduced in the near future.

Inventory and rate of generation of spent fuel from NPP operation

The major part of the spent fuel was shipped back to the Soviet Union (later Russia) between 1989 and 1998. However, in the 1990's, contrary to the terms of the original agreement though in accordance with international practice, the responsible Russian authorities wanted Hungary to take back the residual radioactive waste and other by-products created during reprocessing. Therefore the licensing and construction of an interim spent fuel storage facility started in 1993.

As of 31 December 2016, a total of 1800 fuel assemblies were stored in the spent fuel ponds in the nuclear power plant, and 8707 fuel assemblies were stored in the Spent Fuel Interim Storage Facility. Taking into account the new 15 month fuel cycle of the nuclear power plant 7210 spent fuel assemblies will be generated between 2017 and 2038 (until the shutdown of the four reactors).

Rate of generation of LLW/ILW from small sources

About 10 m^3 of LLW/ILW and 1000 - 1500 spent sealed radioactive sources (partly from smoke detectors) arise annually from small non-NPP sources outside the nuclear power industry. Most of these radioactive wastes, including the spent sealed sources, are generated in medical, industrial and research applications.
The most widely used radionuclides are ^{60}Co, ^{137}Cs, ^{90}Sr and ^{3}H.

RADIOACTIVE WASTE MANAGEMENT POLICIES AND PROGRAMMES

National Framework

The Hungarian Government places special emphasis on establishing and maintaining a national framework of radioactive waste management that fulfils the requirements of the European Union as well as complies with international legal instruments, standards and best practices. Hungary complies with Council Directive 2011/70/EURATOM (establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste), and transposed its requirements into the national law.

The Government made significant headway in this field, as it elaborated its National Policy and National Programme on spent fuel and radioactive waste management. The National Policy was adopted by the Parliament in its resolution 21/2015. (V. 5.) in April 2015.

The National Programme – as a roadmap – contains the technical solutions for carrying out the principles of the National Policy. The National Programme was completed and approved by the Government in August 2016 in Government Decree 1459/2016. (VIII. 24.).

Waste management policies

First, the policy of the back-end of the nuclear fuel cycle is based on the "do and see" principle which ensures that the decisions are made on time, as needed, taking into consideration the most advanced technological developments as well as available international services. Thus, no decision has been taken and approved yet on the back-end of the nuclear fuel-cycle.

Second, the radioactive waste management policy prescribes that low and intermediate level waste which was generated in Hungary shall be disposed of in radioactive waste disposal facilities in Hungary. This requirement is fulfilled by the Radioactive Waste Treatment and Disposal Facility for institutional waste and by the National Radioactive Waste Repository for the waste generated in the nuclear power plant.

The disposal of high-level waste shall be solved by building a deep geological disposal facility in Hungary, irrespective from the way how the fuel cycle is closed. The technical and economical preparation for the establishment of a HLW repository is based on a reference scenario, supposing the direct disposal of spent fuel. In this procedure the national and international developments shall be taken into account by revising the National Policy and National Programme accordingly. As the Spent Fuel Interim Storage Facility provides for 50 year storage of the spent fuel from the NPP, it is not urgent yet to take the decisions on the closure of the nuclear fuel cycle. However, the deadline for commissioning of a HLW repository has to be in accordance with the schedule of the decommissioning of Paks Nuclear Power Plant and in this respect the National Policy prefers a deferred decommissioning after 20 years of safe enclosure.

The Public Limited Company for Radioactive Waste Management (PURAM) – designated by law – is responsible for the execution of the tasks defined in the national policy and in the national programme. It has been in operation since June 1998.

Programmes and projects

Interim storage of spent fuel

Interim storage of spent fuel from Paks Nuclear Power Plant takes place in the Spent Fuel Interim Storage Facility in Paks. The storage is assured for 50 years and the capacity of the facility has been and is going to be extended as necessary.

The Spent Fuel Interim Storage Facility is a modular vault dry storage type facility designed for the storage of spent nuclear fuel. It is a surface facility, in which the fuel assemblies are stored separately in vertical position, installed in airtight sealed storage tubes, filled with inert gas (nitrogen).

By the end of 2016 the Spent Fuel Interim Storage Facility consisted of 20 vaults (16 with 450 fuel assemblies/vault and 4 with 527 fuel assemblies/vault) and further four vaults were in the phase of commissioning. The planned 36 vaults are assumed to be capable of storing all spent fuel until the end of the extended service life of the plant. These data are not final, there are plans to further increase the capacity of the vaults.

Disposal of HLW

The preparations for the disposal of high-level and long-lived radioactive waste in a deep geological repository started in 1995 in the Boda Claystone Formation, in the Mecsek Mountain area. The investigations were, however, repeatedly interrupted due to financial difficulties, and a revision of the whole program became necessary. To this end PURAM developed a new investigation plan, approved by the competent authority in 2013. The purpose of the on-going surface-based exploration is to select the target site and provide its general characterization. Detailed geological characterization will also take place in this phase. The last phase of the surface-based investigation aims at the site selection of an underground research laboratory. PURAM intends to complete this site selection process by 2030, the planned end date of surface-based investigation.

Disposal of LLW/ILW from the Paks NPP

In 1993 a national project was launched to solve the final disposal of LILW of NPP origin. The selection of the site started in the framework of this project with due consideration of the opinion of the population living in the region. Further explorations were proposed in 1996 to assess the possibility for the underground disposal of wastes in granite host rock in Bátaapáti, 200-250 m below surface. Bátaapáti is situated about 45 km south-west of Paks. The objective of the underground exploration plan focused on the identification of the host rock volume intended to accommodate the repository.

Two important events occurred in 2005. A referendum was held in the settlement upon the initiation of the Bátaapáti Municipal Council. Nearly 90.7 % of the large number of voters agreed that a LILW disposal facility shall be constructed in Bátaapáti. (The voter turnout reached 75%). On 21 November, 2005 the Hungarian Parliament granted its preliminary permission in principle for the start of the preparatory work of the construction of a LILW disposal facility, the National Radioactive Waste Repository on the area which was previously qualified as acceptable from a geological point of view. Based on the environmental impact assessment and the pre-construction safety assessment, the appropriate licences were issued,

and in October 2008 it became possible to transport waste from the Paks NPP to the new technology building for buffer (predisposal) storage.

A new milestone was achieved in December 2012, when the operation of the first underground disposal chamber started. In 2017 the second disposal chamber was in the phase of commissioning, and further two chambers were excavated.

Treatment and disposal of radioactive waste from small sources

The Radioactive Waste Treatment and Disposal Facility was commissioned in 1976; it was established for the management of low and intermediate level radioactive wastes originating from small sources outside the nuclear power industry. It is situated at Püspökszilágy, approximately 40 km northeast of Budapest. The repository is a typical near-surface facility with a capacity of 5040 m^3, comprising concrete trenches, or vaults, and shallow wells for spent sealed sources. By the end of 2004 the capacity of the repository was exhausted.

In the past years, the activities focused on demonstrating the safe operation of the facility and determining the necessary measures for its future closure. In this regard some reconstruction and upgrading have been completed, and safety assessments have been carried out, resulting in a safety enhancement programme. This programme is realised in a step-wise fashion. First a so called demonstration program was accomplished to test the recovery technology and collect the necessary information and experience. Long-lived waste and sources were removed from four vaults to be stored in the technology building, pending re-disposal in a HLW repository, the recovered short lived waste was – as possible – compacted, thus free capacity was gained in the vaults.

Based on the results of the demonstration programme, the next phase of the safety enhancement programme was prepared and its execution will start in 2019 with the vaults in rows I.-II. of the repository.

RESEARCH AND DEVELOPMENT

LLW/ILW treatment and disposal

Methods for boric acid recovery and cesium removal from the concentrated liquid waste at the nuclear power plant were developed. The application of these methods is now in preparation.

Most of the R&D performed in Hungary on disposal of LLW/ILW was concentrated on the selection of a suitable site for a mined cavity type of a repository in the area of Bátaapáti. The research included site investigations, laboratory analysis of borehole samples, determination of soil characteristics (i.e. sorption, water permeability, isotope migration rates, etc.) and performance assessment. Other important areas of R&D include waste characterisation, waste acceptance criteria, and facility design.

HLW

As described under “Programmes and projects”, the Boda Claystone Formation in the Mecsek Mountain area is considered suitable for high-level waste disposal. Currently, investigations are carried out to select a site for an underground research laboratory. The

goals of geological investigations were to characterize the Boda Claystone Formation and to reduce the investigation area to 10–12 km^2. The current geological investigation program covers surface activities, including geological and geomorphological mapping, hydrogeological reambulation, trenching, and the drilling of deep boreholes accompanied by seismic profiling.

DECOMMISSIONING AND DISMANTLING POLICIES AND PROJECTS

The decommissioning policy recommends that the decommissioning plan should include a timing for dismantling – if necessary the safe enclosure period – and the final state of the site after decommissioning in view of the long-term utilization concept of the site. Synergies of nuclear facilities, as well as the application of most advanced technologies shall be paid attention to in the implementation of decommissioning policy.

The regulatory safety codes governing operation of the Paks NPP, the Budapest Research Reactor, the training reactor of the Budapest University of Technology and Economics and the Spent Fuel Interim Storage Facility require that arrangements for decommissioning shall be considered at the plant design stage. A preliminary decommissioning plan is an obligatory part of the licensing documentation to be submitted prior to commissioning. This plan must be updated regularly in accordance with the regulations in force and submitted to the regulatory body. The decommissioning of the Hungarian nuclear facilities is not foreseen in the near future.

The design lifetime of the nuclear power units at Paks NPP was originally 30 years, but now a 20 years lifetime extension project is in progress which is for three units already accomplished. The preferred option for Paks Nuclear Power Plant is a deferred decommissioning after 20 years of safe enclosure.

TRANSPORT

The Hungarian regulation on transport of radioactive material is based on the relevant international conventions. The Hungarian Atomic Energy Authority is the competent authority for licensing of transport packages and transport arrangements. The same general rules should be applied to the transport of radioactive waste as to radioactive material. In addition, the transport of radioactive waste across national borders should take place in accordance with the European Union Directive on transboundary shipment of radioactive waste. [1]

The transport of radioactive waste to the National Radioactive Waste Repository and – to a large part – to the Radioactive Waste Treatment and Disposal Facility is organised by PURAM using its own work force and equipment.

[1] Council Directive 2006/117/Euratom of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel

COMPETENT AUTHORITIES

The Act CXVI on Atomic Energy of 1996 (hereinafter referred to as the Act on Atomic Energy) and its executive orders establish a comprehensive and up-to-date regulatory system. The principal licensing and supervising authority for spent fuel and radioactive waste management is the Hungarian Atomic Energy Authority (HAEA). It is an independent government office,, supervised by a minister appointed by the Prime Minister. The resolutions of HAEA can only be appealed and amended in court.

As far as radiation protection is concerned, the Act on Atomic Energy (as amended) assigns the regulatory tasks basically to the Hungarian Atomic Energy Authority. The minister responsible for health fulfils the regulatory tasks in the field of radiation health through the ministry directed by him, and through certain designated government offices.

The Act on Atomic Energy defines and allocates the competences and tasks also of other public administration bodies involved in the application of atomic energy. In the licensing processes, technical aspects - within their competence - are enforced by legally designated co-authorities, the opinions of which shall be taken into account by the HAEA.

Protection of the environment - including the general regulation of releases - belongs e. g. to the minister responsible for environmental protection. The minister responsible for emergency preparedness defines the rules of fire protection in the application of atomic energy and the means of the enforcement of these rules. The tasks of the police in connection with the application of atomic energy are regulated by the minister responsible for law enforcement.

FINANCING

Under the Act on Atomic Energy a Central Nuclear Financial Fund was set up in January 1998 exclusively for financing radioactive waste disposal, interim storage of spent fuel, closure of the nuclear fuel cycle and decommissioning of nuclear facilities. The minister supervising the Hungarian Atomic Energy Authority (HAEA) has jurisdiction over the Fund, while the ministry led by him is responsible for its administration (now it is the Ministry for National Development). The Central Nuclear Financial Fund – established from the payments of waste generators – is a separate state fund pursuant to the act on public finances.

The annual amount of payments into the Fund by the Paks NPP are proposed by the minister, in the process of preparing the Central Budget. The payments should cover all costs of radioactive waste and spent fuel management and decommissioning. They are based on the submittal of PURAM, preliminary assessed by the HAEA.

The institutes and businesses, other than the Paks NPP, which dispose of radioactive waste in the Radioactive Waste Treatment and Disposal Facility are also liable for contributions to the Fund as regulated in the annex of the Act on Atomic Energy. For those nuclear installations financed from the central budget (the Budapest Research Reactor and the training reactor of the Budapest University of Technology and Economics), payment into the Fund is provided from the central budget, as required.

In order to ensure that the Fund maintains its value, the Government annually contributes to the Fund with a sum that is calculated on the average assets of the Fund in the previous

year using the average base interest rate of the central bank of the same period. At the end of 2016 the total sum accumulated in the Fund amounted to 269,0 billion HUF.
(1 Euro ~ 311 HUF).

The Central Nuclear Financial Fund is managed within an individual account of the Hungarian State Treasury. The State Audit Office of Hungary audits the budget planning of the Fund and the execution of the budget plan when auditing the central budget. Beyond these regular audits, in 2015 the State Audit Office of Hungary audited the asset management activity of PURAM.

PUBLIC INFORMATION

For more information, the websites of the relevant organisations are listed below.

Government:

The Hungarian Atomic Energy Authority (HAEA)
Website: http://www.haea.gov.hu

Management:

Public Limited Company for Radioactive Waste Management (PURAM)
Website: www.rhk.hu

Research:

Hungarian Academy of Sciences Centre of Energy Research (MTA EK)
Website: http://www.energia.mta.hu
Institute of Nuclear Research of the Hungarian Academy of Sciences (ATOMKI)
Website: http://www.atomki.hu/
National Research Directorate for Radiobiology and Radiohygiene (OSSKI) of the National Public Health Center
Website: http://www.osski.hu
Nuclear Safety Research Institute Ltd. (NUBIKI)
Website: http://www.nubiki.hu
Institute of Nuclear Techniques of the Budapest University of Technology and Economics (BME NTI)
Website: http://www.reak.bme.hu/
Department of Physical Chemistry at the University of Pannonia
Website: http://www.fizkem.mk.uni-pannon.hu