PURAM
PUBLIC LIMITED COMPANY FOR RADIOACTIVE WASTE MANAGEMENT

NRWR

National Radioactive Waste Repository

FOREWORD

Dear Reader,

The publication you are holding in your hands is about a Hungarian engineering facility, the National Radioactive Waste Repository (NRWR) located in Bátaapáti, SW Hungary.

Hungary is bound by both international and national regulations regarding safe management of radioactive waste resulting from the use of nuclear energy. This is the reason the Act CXVI of 1996 on Atomic Energy (Atomic Act) was created, stipulating that all tasks related to the interim storage and final disposal of radioactive waste and spent fuel must be performed by the organization designated by the Government. Thus, since its establishment on 2 June 1998, the Public Limited Company for Radioactive Waste Management (PURAM) has been responsible for these tasks.

The National Project for the Disposal of Low and Intermediate Level Radioactive Waste generated by Paks Nuclear Power Plant (NPP), was launched in 1993.

Following a lengthy period of surface research, social dialogue with the municipalities of the affected region, and a successful referendum held in Bátaapáti, confirming the agreement of the rezidents, the decision was taken to build a safe repository for the above-mentioned waste, 250 metres below ground level.

Bálint Nős, Managing Director

The underground works started in 2005, by excavating two inclined access ramps. In 2008, the NRWR's surface facility was inaugurated at a formal ceremony and the first waste packages were transported from Paks NPP to Bátaapáti.

The next milestone was reached in December 2012, when the first underground disposal gallery (I-K1) was opened, which allowed for additional waste packages to arrive from Paks NPP, in parallel with the delivery of the 3,000 drums stored in the surface facility. The first disposal gallery was filled in 2017, with a total of 4,833 drums in 537 steel-reinforced concrete containers. Simultaneously, the technological installation of the second gallery (I-K2) was also completed. The disposal concept of the second gallery was fundamentally different from the previous one. Transport of the so-called compact waste packages (CWP) from the NPP to the NRWR started in 2023.

The excavation works of the third and fourth galleries for the extension of the repository have been completed in 2015. The operation and ongoing extension of the NRWR will further continue for decades to come, ensuring that a sufficient number of disposal galleries are available for the safe disposal of low and intermediate level radioactive waste.

Meanwhile, at the Radioactive Waste Processing and Storage Facility located at the border of Püspökszilágy and Kisnémedi, we have started a safety enhancement programme. This modernisation has justified the need to provide more space at the site, thus in 2024, drums containing solid low and intermediate level waste were transferred to the Bátaapáti repository in accordance with the NRWR's waste acceptance criteria.

My colleagues and I would like to thank all those who have been involved in these projects, and we are proud that this repository provides solution of high technical standard for a task of national significance.

I warmly recommend to you our publication, presenting the past, present and future of the NRWR.

MANAGEMENT OF LOW AND INTERMEDIATE LEVEL RADIOACTIVE WASTE

Paks NPP plays a significant role in Hungary's electricity supply, nevertheless, radioactive waste is generated during its operation. Depending on its level of radioactivity, radioactive waste is classified as very low, low, intermediate and high level. The Public Limited Company for Radioactive Waste Management (PURAM) is responsible for the safe interim storage and final disposal of radioactive waste.

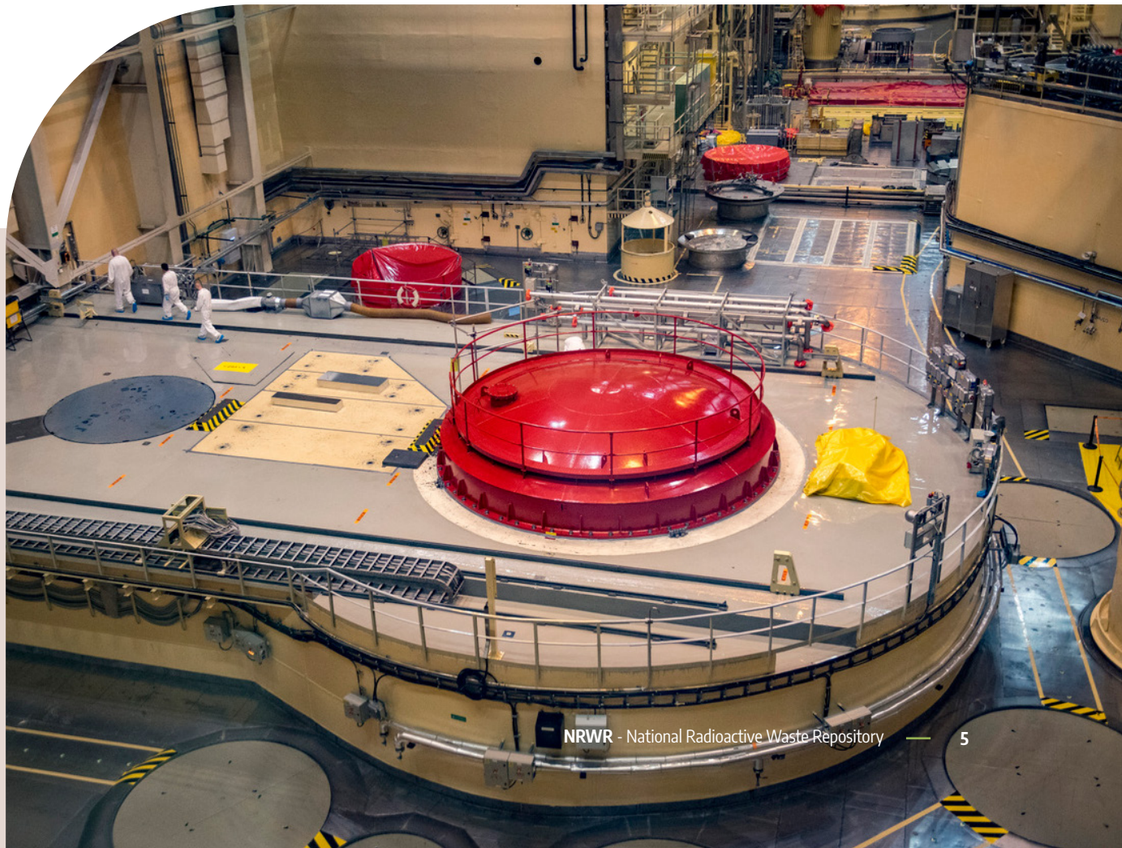
Low and intermediate level radioactive waste generated at the Nuclear Power Plant consists mainly of protective dress and equipment, tools, components and air filters used during operation, which are likely to be contaminated with radioactive material. The other large group of radioactive waste is generated during technological processes. These solid materials are collected and after compaction they temporarily stored in metal drums at Paks NPP.

Liquid radioactive waste is also generated during the operation. Water contaminated with radioactive material is purified and then solidified using a new technology.

Evaporation residues and spent ion exchange resin also have to be collected at the NPP site.

Consequently, the task is to provide final disposal of solid and solidified low and intermediate level radioactive waste at the National Radioactive Waste Repository in Bátaapáti.

The extension of the lifetime of the Paks NPP will certainly increase the amount of radioactive waste, in addition to the amount generated when decommissioning the plant after its shut down. Therefore, new underground disposal galleries will need to be excavated, simultaneously with the operation of the repository.



1982

Start of the first unit of the NPP.

1996

Start of geological investigation in Bátaapáti area.

2003

Surface-based exploration works in Bátaapáti have been completed. Based on the final report of the Hungarian State Geological Institute, the South Transdanubian Regional Office of the Mining and Geological Survey of Hungary declared the area as geologically suitable.

2008

Surface facilities of the NRWR started to operate after an official opening ceremony and the first waste packages from Paks NPP were delivered.

1993

The National Project was launched with the objective of providing a solution for the final disposal of low and intermediate level radioactive waste generated at the nuclear power plant.

1998

The Radioactive Waste Management Non-profit Company was established, and it took over the investigation from the professionals of the NPP, to define the location of the repository.

2005

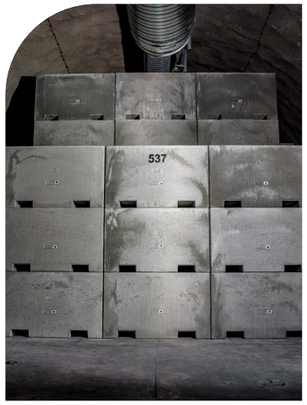
Underground exploration began with the excavation of the two access ramps.

2011

Disposal galleries I-K1 and I-K2 have been constructed.

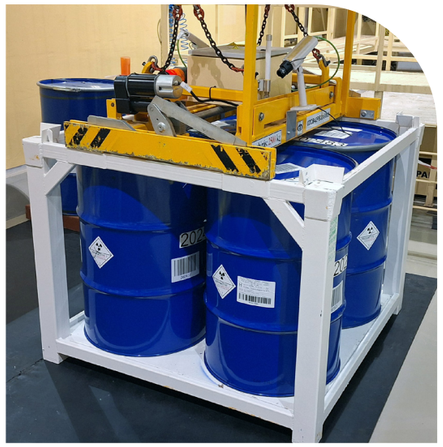
2012

The I-K1 gallery was opened with an official ceremony and the first waste package arrived at Bátaapáti.



2017

The I-K1 gallery was filled with 537 reinforced concrete overpacks containing 4833 drums in total.



2024

Transport of drums filled with waste started from the Radioactive Waste Treatment and Disposal Facility to NRWR.

2015

Excavation works for the I-K3 and I-K4 disposal galleries have been completed.

2023

The first compact waste package (CWP) was delivered to the NRWR.

INITIAL CONCEPT

Strict controls guarantee adequate safety, and are important criteria, applicable from the receival of the radwaste at the site of the NPP. Strict control of waste packages to meet the prescribed waste acceptance criteria of the NRWR is necessary to guarantee the adequate safety of the repository. All drums must be inspected for damage, and gamma dose rate measurements must be taken on their surface and at a distance of one metre. According to the initial concept, each drum was given a unique identification and a barcode, then after being sealed, they were placed on a specially designed transport vehicle, where up to sixteen drums could fit at a time.

The drums were unloaded from the vehicle in the buffer storage hall of the NRWR. In this hall, with a storage capacity of 3,000 drums, quality control tests were performed and the waste was prepared for underground disposal.

After temporary storage in the hall, the drums were placed in steel-reinforced concrete overpacks (9 drums in each container) and the gaps between them were filled with 1,6 cubic metres of concrete. The filled up, closed concrete containers were left in the hall for a setting period of 7 days.

A special vehicle transported the heavy (up to 16 metric tonnes) concrete containers underground, along the Western access ramp. At the entrance of the disposal gallery, a forklift took over the container and placed it into its final position.

The two parallel access ramps, with a slope of ten per cent, are about 1700-1700 metres long each.

The access ramps are connected every 250 metres by cross-cutting tunnels. The size of the cross-section of the access ramps varies between 21 and 33 square metres.

Construction workers – under the supervision of Mecsekérc Ltd. – excavated a total of more than 5 kilometres of drifts, producing almost 190,000 m^3 of granite.

The repository is located at a depth of 250 metres below the ground surface.

The I-K1 disposal gallery has been filled up, with a total of 537 steel-reinforced concrete overpacks containing 4833 drums.

The size of the cross-section of the first and second disposal galleries is 96 m^2, the third and fourth disposal galleries has a cross-section size of 115 m^2, and the fifth and sixth disposal galleries will have a cross-section size of 135 m^2.

Excavation of the I-K3 and I-K4 disposal galleries have been completed and technological installation is currently in progress.

During the further construction of the repository, the location and geometry of the new galleries should be adapted to the geological conditions, as this will result in a more economical and safer design of the disposal galleries.

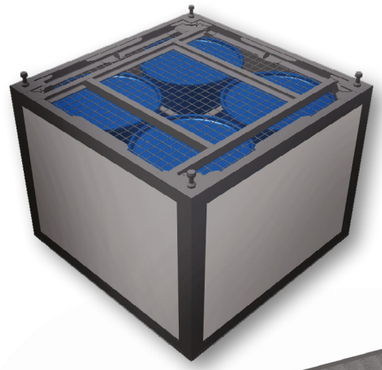
NEW CONCEPT

In parallel with the commissioning of the first disposal gallery, the optimisation of the disposal concept of the NRWR was started. This involved the development and licensing of a new repository concept and disposal system that would allow for the construction of more galleries and a more efficient use of the excavated space in the disposal galleries, while maintaining the same level of safety.

The optimisation process covered all elements of the disposal system. Thus, by considering the waste package and the engineered barrier system as a whole, the disposal of the so-called compact waste packages (CWP) in concrete vaults constructed inside the excavated galleries, was proven by the analyses to be significantly more efficient, than the previous disposal method with the steel-reinforced concrete overpacks. A slight increase in the geometry of the disposal galleries to match the size of waste package piles allowed further efficiency gains.

The engineered barrier system has been reviewed considering the compact waste package. The objective was to replace the reinforced concrete container with an element fulfilling the same safety function. This led to the idea of building a reinforced concrete vault inside the disposal gallery. The walls of the vault are in direct contact with the walls of the excavated disposal gallery.

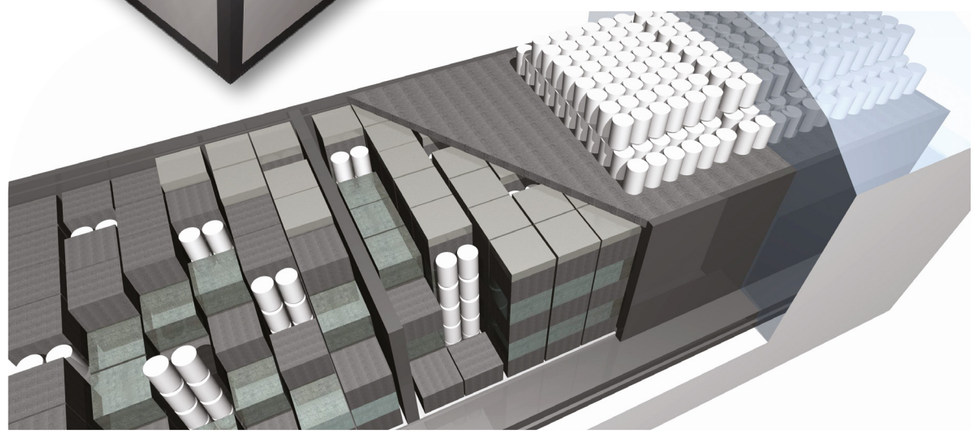
In the new compact waste packages, 4 metal drums of 200 litres each are placed in a thin-walled, steel container, and the space between the drums and the wall of the container is filled with cement slurry prepared from liquid radioactive waste. The CPWs are produced at the Paks NPP using cementation technology, then these packages are received by PURAM and delivered to the NRWR for final disposal.



As soon as a section of the vault is filled up with CWPs, a cross-wall is constructed in the vault, and the space between the CWPs is filled with inert concrete (gap filling) to protect the CWPs against corrosion. After that, the top concrete slab of the vault is constructed, and waste drums are placed on top of the vault. In this so-called crone-space above the vault, the gap between the drums and the walls of the excavated disposal gallery is backfilled with concrete.

In July 2023, the first CWP was delivered to the NRWR, so their disposal in the I-K2 gallery will start soon.

A comparative cost analysis of the original and the new disposal concept was carried out. Introduction of the new disposal concept will result in significant cost savings related to the disposal of operational radioactive waste generated during the 50-year operation of the Paks NPP. The cost efficiency will be further increased by increasing the size of the cross-section of the galleries.



TRANSPORT OF WASTE PACKAGES FROM THE RADIOACTIVE WASTE TREATMENT AND DISPOSAL FACILITY

Based on the analyses performed for the Radioactive Waste Treatment and Disposal Facility (RWTDF) in Püspökszilágy, it was concluded that safety enhancing measures should be implemented to ensure long-term safety of the waste storage. During this programme, waste disposed off in the 1970s and 1980s will be extracted from the near-surface concrete vaults, sorted and repackaged, to ensure disposal that meets today's requirements.

In recent years, the site's final waste disposal vaults have been filled up and the capacity of the temporary storage units has become increasingly scarce. In order to ensure continuous operation of the repository, it is necessary to create some empty storage space. In addition, the implementation of the safety enhancement measures will require a large amount of interim storage capacity, and therefore additional storage space will need to be established.

Therefore, PURAM decided to transport part of the drums stored in the interim storage facility of the RWTDF to the NRWR in Bátaapáti, for final disposal. Only those waste packages can be transported that are fully comply with the current waste acceptance criteria and disposal technologies of the NRWR, i.e. acceptance and final disposal of these drums does not require any technological modifications.

Under the current operational licence of the NRWR, the 200 L metal drums from the RWTDF may be placed either inside the concrete vault of the I-K2 disposal gallery, either on the top of the vault, in the crown-space, the same way as the drums arriving from the NPP.

ENVIRONMENTAL MONITORING

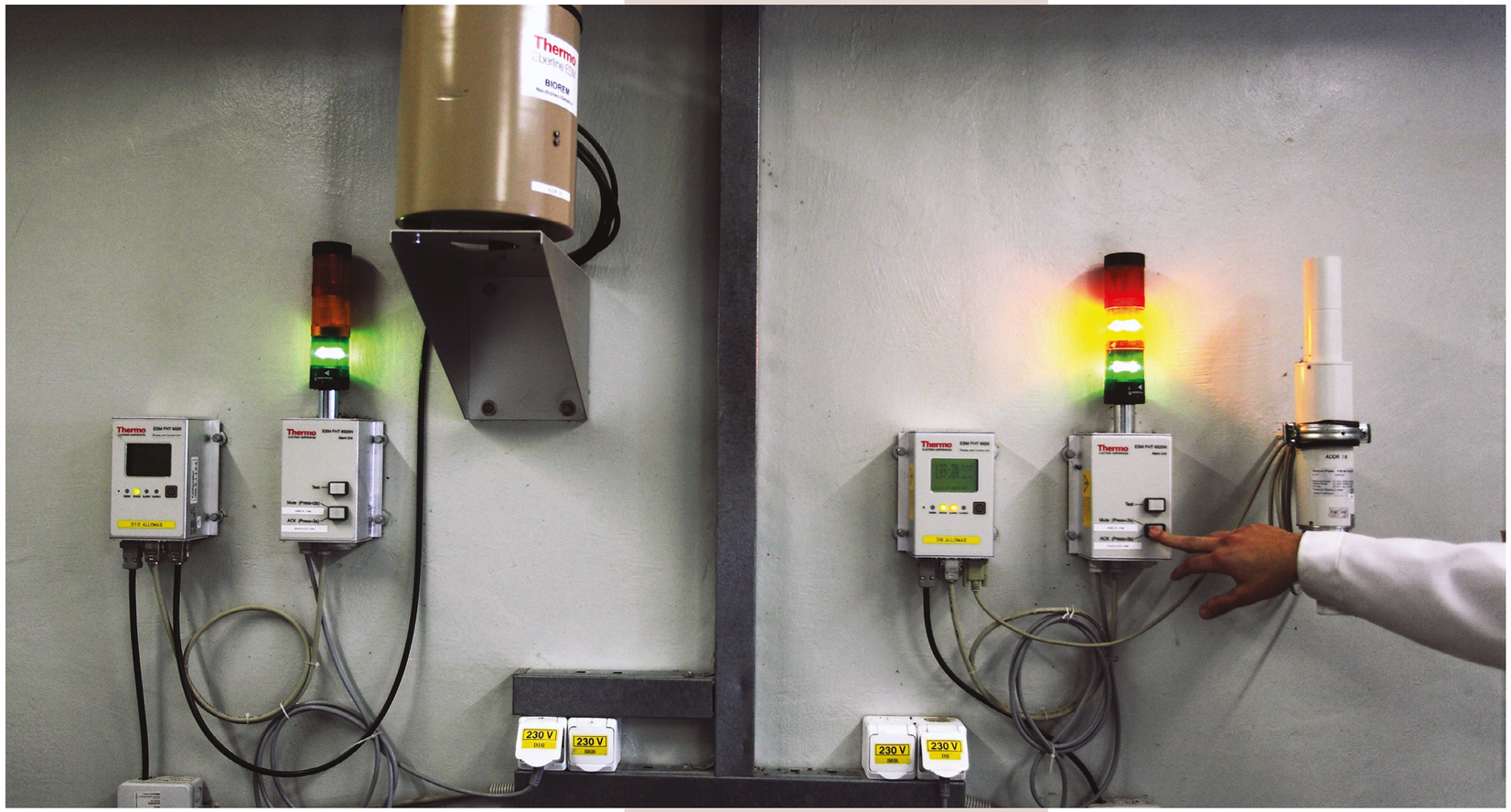
The most important requirement for a radioactive waste repository is its safety, and this must be proven. Operation of a well-established environmental monitoring system, processing, evaluation and presentation of the monitoring results will create and strengthen the trust of the people living in the region.

The aim of long-term environmental monitoring is to provide information on the effects and trends of natural and man-made processes in the environment, i.e. to provide information and possible forecasts. This work consists of three sub-areas: radiological, environmental and geotechnical monitoring.

The aim of radiological monitoring is to detect any changes or trends in the radiation conditions (e.g. in activity levels, gamma dose rate) in the vicinity of the repository, based on regularly taken samples and measured data. Considering the specificities of the repository and the environmental conditions, five complex radiological monitoring stations were installed around the surface facility. Radiological monitoring of emissions is performed at fixed sampling points. Measurement results show that the emission limits set by the authority are fully respected, with the activity of the radionuclides emitted being consistently several orders of magnitude below the permitted limit values.

The repository itself is also monitored by a radiation protection monitoring system. Readings of the installed measuring devices are recorded in the central control portal, from where the data and alarm signals are displayed in the dosimetry control room.

Based on the results of the surveys and investigations carried out in the vicinity of the repository, it can be concluded that the level of radioactivity has remained at the same level as the baseline since the repository was commissioned, i.e. the operation of the repository does not impose any additional burden on the environment.



COMMUNICATION

PUBLIC RELATIONS

In accordance with the Atomic Act, it is essential to provide regular information on all activities and measures taken in relation to the management and disposal of radioactive waste. This includes not only the dissemination of information, but also having a meaningful dialogue with the rezidents living in the areas affected by our activities. Thus, taking advantage of the possibilities offered by the Atomic Act, we inform the stakeholders not only by our own communication channels, but also through the control and information organizations of the local municipalities.

One of the key responsibilities of PURAM is to provide continuous and credible information about its activities to all the people affected by its programmes. In order to promote regional communication and professional dialogue, the company cooperates on a contractual basis with the association of municipalities representing the local communities. As a result of the work with the Social Control Information Association, which has been operating since 1997, the support and trust of rezidents of the surrounding municipalities has continued to this day, and extends to the operation of the repository and the activities of PURAM. This is also confirmed by opinion polls carried out every two or three years, providing feedback on the PURAM's communication activities.

In order to involve the public even more effectively in our programmes and to provide them with more comprehensible information, PURAM performs its communication activities through a variety of channels and in different forms. To this end, we have been operating a visitor centre on the site since 2015, offering an insight into the work of the company.

'Open days' provide an exceptional opportunity to allow access to visitors to our branches and to learn about technologies and visit sites that are normally closed to the public.

In addition, an Electronic Newsletter is published several times a year, reporting on the activities of the past months, and also provides periodical technical material for the Social Control Information Association.

The younger generation is one of our key target groups, so PURAM participates in school programmes to provide information and on career guidance days to give them an insight into the work of our company. Year after year, PURAM aims to improve and find new channels to inform in a more accessible and relevant way the children of today, who may become decision-makers of the future.

INTERNATIONAL RELATIONS

Professionals of PURAM are convinced that the use of international experience is indispensable for the effective operation of the Company. The Atomic Act lays down the principle that the safety of the nuclear energy use must be promoted by incorporating the results of domestic and international scientific research. This also applies to the management of radioactive waste and spent fuel and the related R&D tasks.

With all of this in mind, PURAM strives to be present in many international cooperation programmes, for example, by being represented at meetings of the International Atomic Energy Agency (IAEA) based in Vienna and the professional governing bodies of the OECD Nuclear Energy Agency (OECD NEA) based in Paris.

Within the framework of technical cooperation coordinated by the IAEA, PURAM regularly receives professional visitors from abroad.

In addition to the cooperation schemes with the major international organisations, PURAM is constantly striving to maintain and develop its bilateral relations with professional waste management organisations in other countries.

Coordinated organisation of scientific and technical research and development work is inconceivable without the use of international experience.

PURAM

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THE **SAFETY**
OF OUR FUTURE,
THE **RESPONSIBILITY**
OF OUR PRESENT