SFISF

Spent
Fuel
Interim
Storage
Facility

FOREWORD

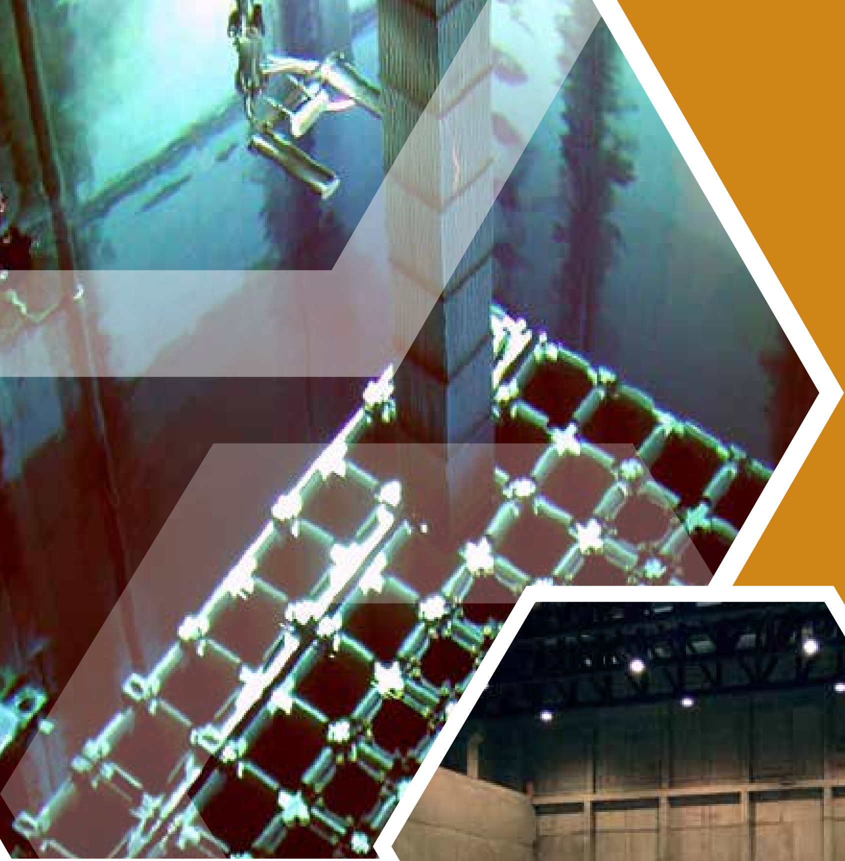
According to the Hungarian Act on Atomic Energy (1996) *„ an organisation shall be appointed by the Hungarian Government, which shall be responsible for the final disposal of radioactive waste, as well as for the interim storage and final disposal of spent fuel, furthermore this organisation shall carry out the tasks related to the decommissioning of nuclear facilities, as these tasks are in the best interest of Hungary."*
To fulfil the tasks specified in the Act the Hungarian Atomic Energy Authority on July1, 1998 established the Public Limited Company for Radioactive Waste Management (PURAM). The company operates as a non-profit limited company since 2009. PURAM is responsible for planning, commissioning and operating tasks.
During the operation of the Paks Nuclear Power Plant, approximately 400 irradiated fuel assemblies are annually removed from the reactors. Between 1989 and 1998, most of these were transported back to the manufacturer; however, this practice became more and more uncertain, therefore an interim storage facility was needed to be built. The Spent Fuel Interim Storage Facility (SFISF) commenced its operation in 1997.
One of the preconditions for the undisturbed operation of the Paks Nuclear Power Plant is the operation and continuous expansion of the SFISF. Due to the modular design, the facility may be expanded at the pace, and to the extent necessary. One of the company's most important tasks is the safe operation of the storage facility, and that there are sufficient capacities available for the storage of spent fuel at all times.
The Act on Atomic Energy of Hungary declares that the public shall be regularly informed of scientific, technical and other matters related to nuclear energy with the help of the public information systems. This publication has been issued for that purpose.

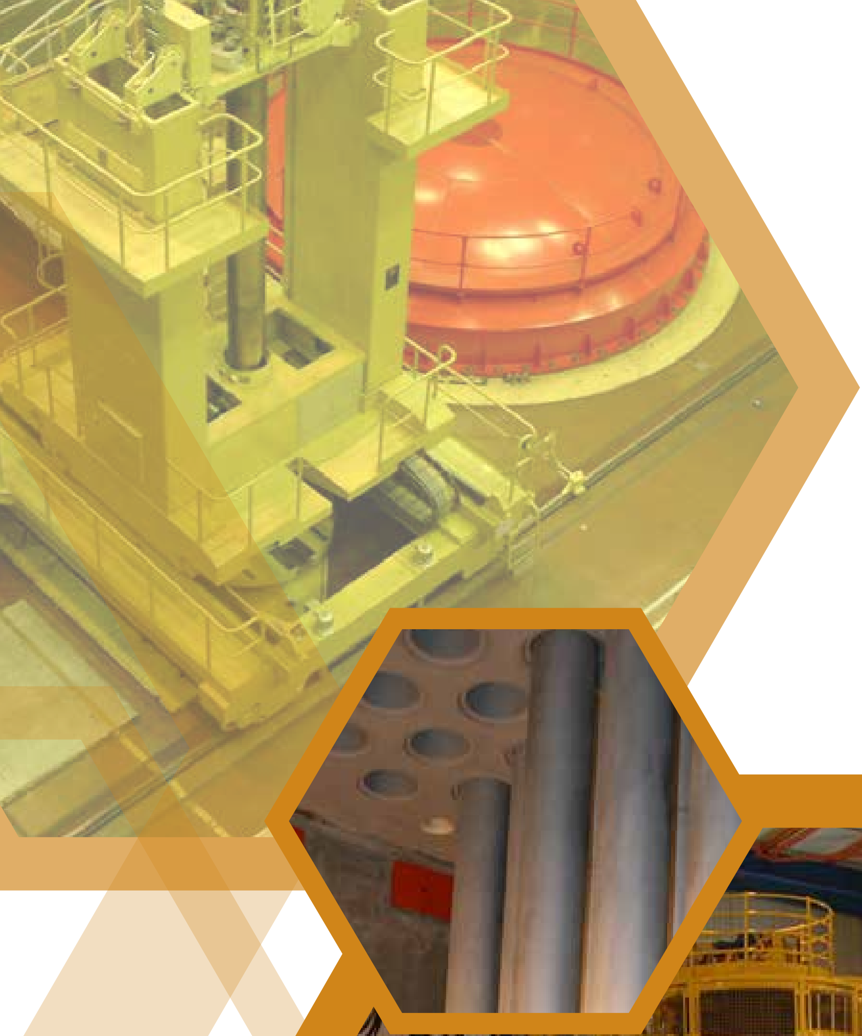
THE OPTIONS FOR MANAGING SPENT FUELS

As a result of the operation of nuclear power plants spent fuel is generated, which then must be properly managed and stored.

After the spent fuel is removed from the reactor, the fuel assemblies remain at the NPP in water-cooling for 3-5 years. During this resting period, radioisotopes that have short half-life decay, also remanent heat is significantly decreased.

At present there are three options for safely managing spent fuel assemblies. The first is the open fuel cycle, when spent fuel assemblies are deposited in a deep geological repository without any reprocessing, where safety is ensured with engineering barriers. The second option is the closed fuel assembly cycle. In this case, during reprocessing uranium and plutonium is retrieved from the spent fuel assemblies. The third option is an approach called „wait and see": spent fuel assemblies are stored in interim storage facilities for an extended period, until a decision is made in regard of their reprocessing or final disposal. Interim storage is necessary in both cases; however, the length of storage depends on the chosen solution.





VAULT TYPE STORAGE OPTION

Different countries operate or plan to operate different types of wet and dry type storage facilities. Currently most countries have chosen dry storage type facilities for long-term interim storage due to lower operation costs and that the cooling does not require external energy input. This also simplifies further conditioning and final disposal.

Vault type storage facilities are such ferro-concrete structures that contain a matrix of storage tubes. These vaults are suitable for housing one or more fuel assemblies. The concrete structure provides shielding and protection. Heat removal is ensured by circulating air or gas around the fuel assemblies, as well as around the external surface of the storage tubes. Finally, the air or gas is released into the atmosphere or it is cooled down via secondary heat exchanger.

The vault design with natural circulation is such a passive system that provides long-term storage for spent fuel assemblies that had been previously rested. Air circulates through the storage tubes propelled by the chimney effect (air-thermosiphon) generated by the remanent heat of the assemblies. This is a self-controlled system, as the more heat is transferred to the cooling air; the more air is sucked in through the inlets as the result of the thermosiphon effect. This phenomenon ensures continuous and sufficient cooling without the need for active technological systems and personnel supervision.

Such storage facilities operate in Canada, France, United Kingdom, United States of America and Hungary.

NATIONAL SITUATION

There are four VVER-440 type reactor units operating at the site of MVM Paks Nuclear Power Plant Ltd. The first unit was commissioned in 1982, the fourth was commissioned in 1987. The original planned lifetime of these units were 30 years, and one of the most important tasks of the present is the technical substantiation of lifetime extension for a further 20 years by ensuring ongoing safe operations.

Electricity is generated from fuel assemblies containing altogether 42 tons of uranium-dioxide per unit. After burnout, these assemblies are removed from the reactor and stored under water in the spent fuel pools located adjacent to the reactor. At this point nuclear chain reaction no longer takes place, however radioactive decay still generates some heat. Approximately 100 spent fuel assemblies are removed from the reactor annually from each unit. Each fuel assembly weighs 215 kilograms.

According to present knowledge and calculations, approximately 17,900 irradiated fuel assemblies generated during the 30 years of original lifetime as well as during the 20 years of extended lifetime need to be stored.

In 1986, Paks Nuclear Power Plant signed a contract with the soviet organisation of commerce to transport back spent fuel assemblies. Based on this contract, Hungary transported 2331 spent fuel assemblies back to the Soviet Union (later on Russian Federation) between 1989-1998.

Due to issues related to transportation the experts of Paks NPP investigated alternative options for storing, treating and disposing spent fuel. The MVM Paks Nuclear Power Plant Ltd. (known at that time as PA Rt.) reached a decision to build an interim storage facility, for which the English GEC Alsthom was contracted in September 1992. The selected design was a modular vault type dry storage facility. The advantage of this particular design is that the facility may be extended as necessary. The facility is suitable for storing irradiated fuel assemblies for at least 50 years. By 1997, the first module – containing three vaults – and the service building had been built. Later on, further modules were commissioned – each containing four vaults – in 2000 and in 2003. A module with five new vaults commenced operation in 2007. This was the last module built to the western side of the building. In 2012, four new vaults were completed in the eastern direction, thus the facility now has a capacity to store more than 9300 fuel assemblies.

THE STORAGE FACILITY

The Spent Fuel Interim Storage Facility is located adjacent to the MVM Paks Nuclear Power Plant Ltd., approximately 5 km south from Paks, and 1 km west of the Danube.
The base line of the facility was designed to be set at a level that ensures the protection of the facility even at the highest flood level. The storage facility has also been designed to withstand a 0.25g horizontal acceleration that may occur every 10,000 years, as required by the nuclear authority. The site of the storage facility is located within the 3 km radius of the protection zone of the Paks NPP, therefore flying in the airspace above the facility is restricted up to 7,000 feet (2,133 meters).
In this type of vault storage facility irradiated fuel assemblies are stored temporarily in vertical position under dry conditions. The most important components of this system are the modules of vault structure built of concrete and steel, over which the main hall is located, built of steel. The storage tube units have removable plugs. Each storage tube houses one spent fuel assembly. Due to the chimney-effect, the airflow through the inlet and outlet channels is an integral part of the storage module.
The reception building is adjacent to the first module, and structurally independent. This part of the facility contains the equipment necessary for the manipulation of the transport container and the fuel assemblies.
The reception building also houses the service and technological rooms, the ventilation and monitoring systems, as well as the staff rooms.



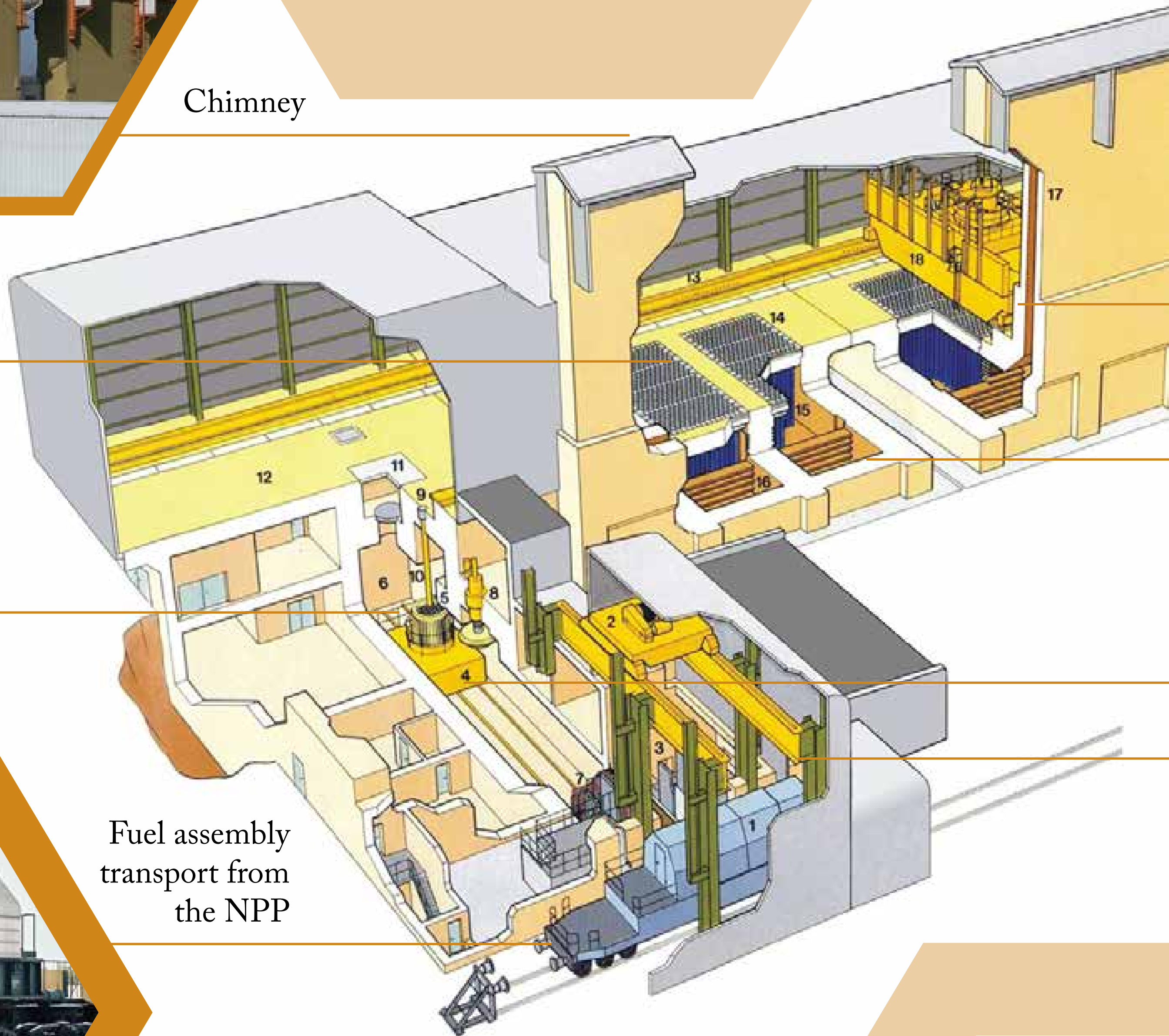


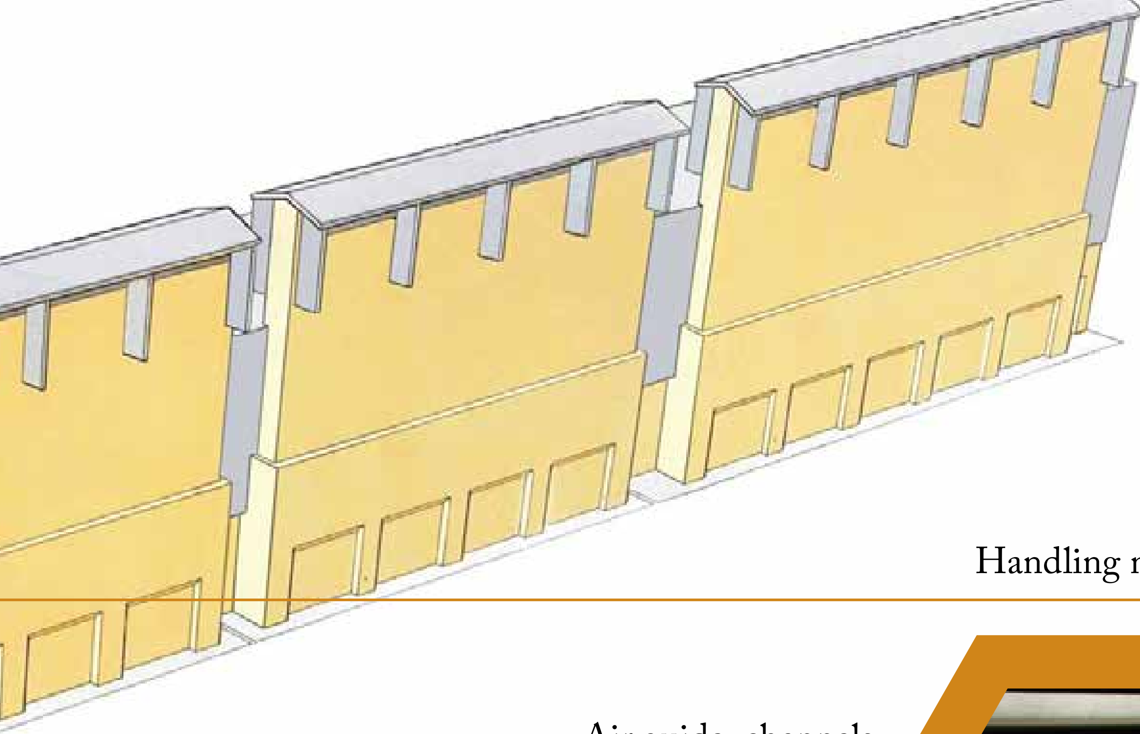
Chimney

Storage tubes

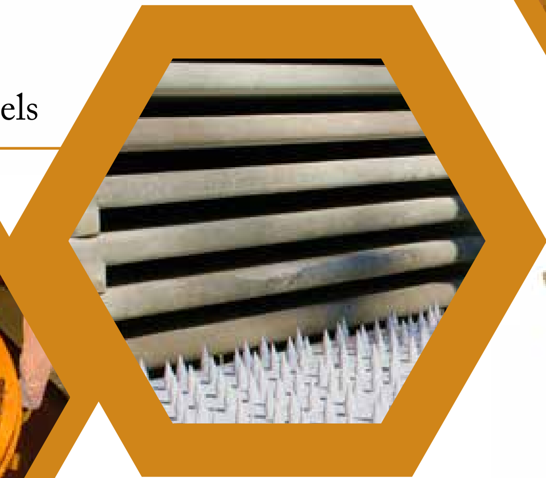
Transport container

Fuel assembly
transport from
the NPP

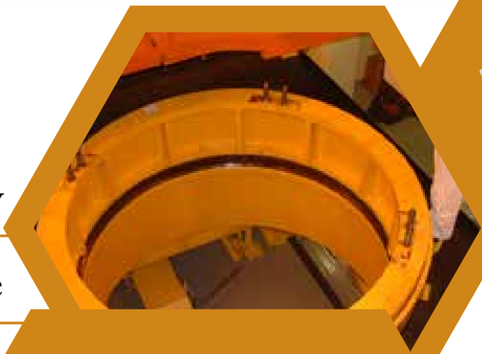




Handling machine



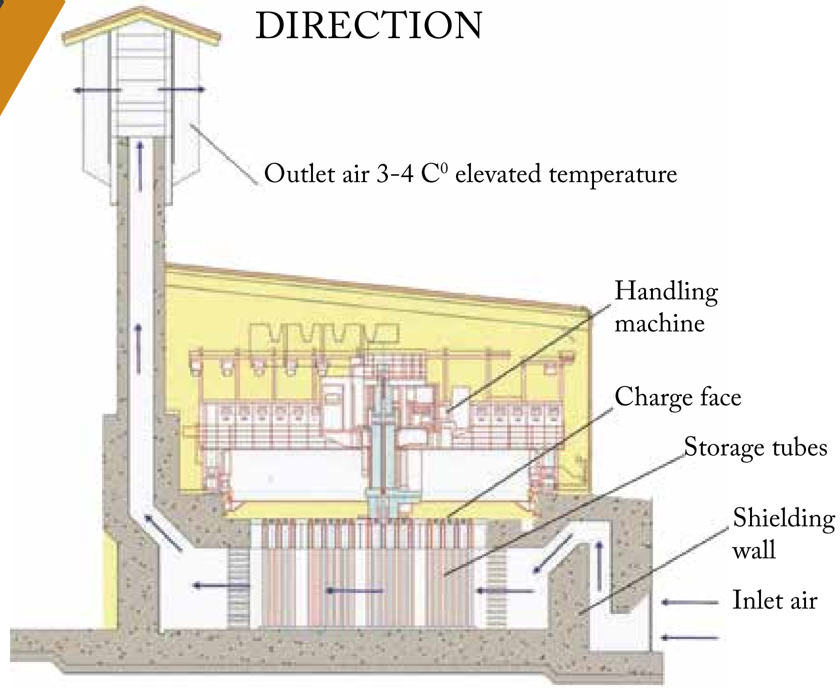
Air guide channels



Transfer trolley

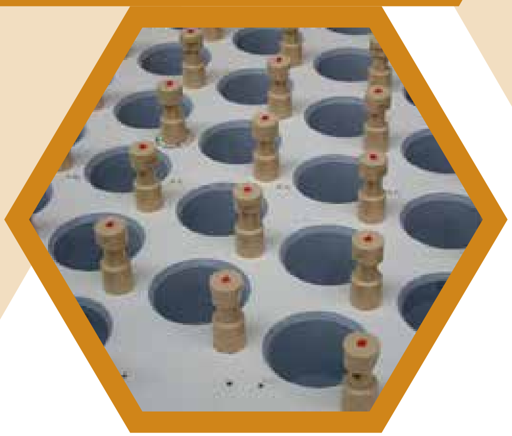
Container handling crane

AIR FLOW DIRECTION



FUEL ASSEMBLY MANAGEMENT

After at least three years of resting, irradiated fuel assemblies are loaded into water filled transport containers. The external surface of the container is decontaminated (potential radiation contamination is removed), then it is transported to the SFISF on railway carriages. Each container may carry up to thirty fuel assemblies. At the storage facility spent fuel assemblies are removed, dried and placed in the storage tubes one by one. During this time the container remains at the unloading position uncovered. Complete unloading the transport container (30 fuel assemblies) requires 120-160 hours.
In the future fuel assemblies may be retrieved fairly similarly, with the use of the refuelling machine, with the modification of some steps.



INSPECTIONS

RADIATION PROTECTION

The radiation protection system of the facility comprises of continuous monitoring and sampling, sample analysis in laboratory, and personal dosimetry inspections.
A network of installed dose rate meters and aerosol monitors provides dosimetry inspections at the site. There are also manual radiation protection devices for personnel.
Based on these measurements the radiation and contamination levels at the facility are insignificant.
Airborne releases are monitored by the isokinetic sampling system and continuous aerosol measurements installed in the ventilation stack of the building. Most of the laboratory measurements are performed in the radiation protection laboratory of the facility.
According to the measurements of releases monitoring, the yearly liquid and airborne releases from the operation of the facility remain constantly well below the relevant limits.
Personal dosimetry is ensured with the use of film dose meters, thermo-luminescent detectors and online electronic dose meters.

ENVIRONMENTAL MONITORING

As the storage facility and the nuclear power plant are located practically at the same site, the environmental monitoring system of the SFISF is integrated into the environmental monitoring system of the nuclear power plant.
Twenty-two installed monitoring stations supply samples within a 30 kilometre radius around the NPP and the SFISF; approximately 25,000 environmental measurements are performed yearly.
The telemetric measurement system provides continuous dose rate measurements in the environment.

SECURITY AND PHYSICAL PROTECTION

The SFISF is a nuclear facility, security and physical protection is provided by the Armed Guards of PURAM. The physical protection system fulfils the regulations and requirements of both international and national legislation. The applied security systems ensure the surveillance of the site, and prevent the entrance or exit of unauthorised persons or vehicles, as well as the unauthorised removal of nuclear materials from under supervision. Entry to the site for both persons and vehicles is just as strict, as it is at the nuclear power plant.

AUTHORITY INSPECTIONS

The operating license of the storage facility was issued by the Hungarian Atomic Energy Authority; while the environmental license was issued by the Central Trans-Danubian Inspectorate for Environmental Protection, Natural Protection and Water Management. The relevant authorities receive reports regularly on operation, safety, release and environmental monitoring.

SAFEGUARDS INSPECTIONS

Obligations of international contracts related to the inspections of nuclear materials and related activities are fulfilled by continuous and comprehensive supervision of said nuclear materials. The International Atomic Energy Authority and the Euratom perform their tasks according to the annual inspection plan, however unplanned inspections may also be carried out. One of the most important areas of inspection is the nuclear fuel records. Nuclear fuel records shall be kept in such a way, that stock can be verified at all times, regardless whether the inspection is planned or unplanned. An annual report is prepared on the stock at that time and reports have to be sent also whenever a change in stocks occur. At present, there are ten surveillance cameras, the number of which shall increase as new modules are built. The cameras of the refuelling machine produce a separate archive for the IAEA, according to which each fuel assembly can be identified, based on its serial number. The IAEA also installed gamma and neutron detectors on the external surface of the drying tube to verify that the moved fuel assemblies are in fact fuel assemblies, and not imitator rods.

EXPANDING THE STORAGE FACILITY

According to calculations – based on the original planned lifetime of the Paks Nuclear Power Plant, and the amount of yearly generated and already stored spent fuel - until 2017 – the end of the original lifetime – altogether 24 vaults are planned to be built. Starting from vault 17, storage tubes shall be positioned in a rectangular form, as opposed to the previously used triangular form, thus 527 assemblies can be stored in a space previously enough for 450 assemblies. This way 11,416 spent fuel assemblies can be stored altogether in the twenty-four vaults. Technical plans allow for thirty-three storage vaults to be built. This space shall be sufficient for storing all spent fuel assemblies generated during the original and the extended lifetime of the reactors.

LONG TERM PLANS

The interim storage facility –after the necessary extensions – shall sufficiently and safely store for decades all spent fuel assemblies that are generated during the operation of the nuclear power plant. During this time the solution for the final disposal of irradiated fuel shall be developed.

Relevant activities commenced at the end of the 90's. Research focused on the Boda Aleurolite Formation in West Mecsek. The results of early investigations determined that this rock formation is most likely suitable for housing such a deep geological storage facility, where spent fuel and high level radioactive waste can be disposed of.

The Hungarian experts working on the end of the fuel cycle continuously evaluate, consider and take into account the latest technical developments and practices. The „Substantiation of the new program related to the management and disposal of radioactive waste and spent fuel assemblies generated in Hungary" document – prepared by PURAM - summarises the possible solutions related to the closing of the fuel cycle. This document determines, as a reference scenario, the direct disposal of spent fuel in Hungary, however, if international practices substantiate an alternative solution that is safe and more beneficial; the option of fuel reprocessing is still possible for a long time.

PUBLIC RELATIONS

The primary communication aim of our company is to gain and to improve the trust of the public in order to ensure that the currently operating and planned nuclear facilities serve this country safely for several decades. Therefore, good relationships with the local public and associations are of utmost importance for us.

The settlements within a 12-kilometre radius surrounding the Paks Nuclear Power Plant and the Spent Fuel Interim Storage Facility have established an information association for the social monitoring of these facilities under the name of Social Control and Information Association (TEIT). Members of this association are Kalocsa (the mayor of Kalocsa is the all-time president of the TEIT), Bátya, Dunaszentgyörgy, Dunaszentbenedek, Fadd, Foktő, Géderlak, Gerjen, Ordas, Paks, Pusztahencse, Tengelic, Uszód.

The municipalities of the TEIT believe that if such a storage facility needs to be built and expanded, this may only happen while ensuring that the public feels entirely safe. Meanwhile these municipalities are entitled for different incentives, thus the local governments receive funding through the association from the Central Nuclear Financial Fund.

The efforts of the TEIT so far verify that local governments can successfully cooperate in order to represent their interests and to gain the trust of their citizens.

In regard of high-level radioactive waste, a deep geological storage solution is preferred; therefore, the area previously investigated in the West Mecsek is the most likely option. As a result, our company continuously communicates with the West Mecsek Social Information Association (NYMTIT) as well. With cooperation, we are able to provide detailed information related to our plans, activities in regard of our HLRW program.

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