REGULATORY EVALUATION OF THE HUNGARIAN NUCLEAR FACILITIES AND RADIOACTIVE WASTE REPOSITORIES IN 2018

Hungarian Atomic Energy Authority

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Preamble

The performance evaluation of nuclear facilities and radioactive waste repositories, besides the licensing and inspection tasks, belongs to the most important elements of the regulatory oversight. A main duty of the Hungarian Atomic Energy Authority (HAEA) is to guarantee nuclear safety, so to prevent the occurrence of a nuclear accident, in the frame established by laws, with the utilisation of the resources that are provided by the Hungarian citizens through their elected representatives. The HAEA, as a part of its nuclear safety regulatory activity, annually evaluates the safety performance of the nuclear facilities, the safety level of their activities.

The main task of the evaluation is to review and assess the operation of the facilities, so to detect deviations with the purpose of prevention preferably in an early phase, to detect their safety effect, to reveal the potential causes, and to initiate effective measures to eliminate any deviations.

The evaluation made by the HAEA is based on the safety performance indicator system developed specifically for nuclear facilities and radioactive waste repositories, the outcomes of inspections, the licensing experience, the regular reports submitted by the facilities and the event reports aiming at the investigation of more significant deviations and their elimination. The primary objective of the authority evaluation is to provide feedback to the licensees of nuclear facilities on the regulatory judgement on nuclear safety related experience gained in the given year, especially on the impact of operatory activities on the public, the environment and the workers of the nuclear facilities.

It can be stated about the year 2018 in general that the nuclear facilities under the regulatory oversight of the HAEA (i.e. Paks Nuclear Power Plant, the new nuclear power plant units to be constructed on the Paks site, the Budapest Research Reactor – BRR, the Training Reactor of the Institute of Nuclear Techniques of the Budapest University of Technology and Economics – BUTE INT TR, and the Spent Fuel Interim Storage Facility – SFISF) as well as the radioactive waste repositories (i.e. the National Radioactive Waste Repository – NRWR and the Radioactive Waste Treatment and Disposal Facility – RWTDF) operated according to the required conditions and parameters during the year. The operation of the facilities did not mean a health risk increment for the employees of the facilities or the public.

In addition to the maintenance and further enhancement of the level of nuclear safety, the most significant tasks of the HAEA for the next year are the regulatory oversight of the improvement measures determined based on the Safety Reviews and the Targeted Safety Reassessment processing the lessons learned from Fukushima, and the licensing and inspection activities to be performed in connection with the new units. These tasks are performed by well-prepared officials of the HAEA with responsibility for the protection of the public and the environment and prevention of the occurrence of events adversely affecting safety.

Gyula Fichtinger
director general of the Hungarian Atomic Energy Agency

Table of Content

1. Introduction

The fundamental tasks and obligations of the Hungarian users of atomic energy and their overseeing Authority, the HAEA are controlled by the Atomic Act.

In line with the provisions of the Atomic Act, the HAEA annually assesses and evaluates the safety performance of the nuclear facilities and radioactive waste repositories falling under its competence. The main goal of the evaluation is to provide feedback to the licensees of nuclear facilities on the regulatory judgement on nuclear safety related results reached in the given year, in order to facilitate the maintenance and enhancement of the quality level of nuclear safety.

Safety has an overriding priority above all other aspects during the application of atomic energy. The fundamental objective of the regulatory oversight of the activities associated with nuclear energy is to ensure that the application of atomic energy shall not cause harm, in any way, to the people and the environment. Another important aspect is that the oversight shall not hinder, more than justified, the operation of facilities and equipment, and conduct of activities associated with atomic energy entailing such risks.

The safety of operation of nuclear facilities and radioactive waste repositories is evaluated by complex numerically quantified characteristics, so-called safety performance indicators. In addition to these indicators, the Authority continuously applies the engineering, safety evaluation, since the safety performance of the facility can be evaluated only as a result of a comprehensive assessment. The comparison with the relevant results and performance indicators of previous years can be significant for the evaluation of the safety performance of the actual year.

The evaluation of safety performance is made based on the assessment and analysis of the conclusions of regulatory inspections, operational data, licensing experience, and events occurred during operation. In order to reach this goal, the HAEA:

- collects operational data and examines the trends;
- gathers the experience of inspections and licensing;
- reviews and evaluates the events occurred during the year;
- performs the safety evaluation of events;
- performs the probabilistic based analysis of events,
- pays special attention to the investigation of human induced and reoccurring events;
- comprehensively evaluates the safety performance with the application of a safety indicator system.

The HAEA takes into consideration the degree of potential hazards during the evaluation of the safety performance of nuclear facilities and radioactive waste repositories being under its regulatory oversight.

The evaluation criteria of safety attributes are determined by the HAEA in a way that takes into account the level of safety performance reached by the nuclear facilities and radioactive waste repositories, the national and international experience on the safety of the application of atomic energy, and to support the licensees in the enhancement of their safety performance.

The first chapter of the evaluation is this introduction; the second chapter contains the summary evaluations for each facility. The methodology of the regulatory evaluation is described in Annex I. Annex II presents the relevant data of the Hungarian nuclear facilities and radioactive waste repositories.

2. Summary Evaluation

2.1 Paks Nuclear Power Plant

In 2018, the facility **operated in compliance with the regulations**. The **values measured during environmental release monitoring remained**, as in the previous years, **below the regulatory limits by orders of magnitudes**.
The operation of the facility **did not present a health risk increment for both the employees of the nuclear power plant and the public**. The occupational radiation exposure level further improved, the collective dose further decreased, and the maximum individual dose got the value within the magnitude of the recent years. The regulatory dose limit for workers, as well as the own objective of the nuclear power plant for individual dose were not exceeded either in 2018.
Based on regulatory authorisation, Paks Nuclear Power Plant modified the earlier used Technical Specifications (hereinafter referred to as TS), it has commenced the application of the Operational Limits and Conditions (hereinafter referred to as OLC) since October 24, 2018. In this report, in relation to the Paks Nuclear Power Plant, the TS is meant as OLC since then.

Figure 2.1-1: View of Paks Nuclear Power Plant (Source: www.atomeromu.hu)

It can be summarised based on the qualification of the safety performance indicators that the area of "smooth operation" showed improving tendency, the area of "operational safety" was adequate, while the area of "commitment to safety" improved.

In 2018, **the area of smooth operation** was characterised by 2 green, 2 yellow and 2 red indicators. In comparison with the preceding year, the number of red indicators decreased by two, the number of yellow indicators increased by two, while the number of green indicators did not change. Among the 17 safety attributes providing basis for the indicators 12 were green, 3 were yellow and 2 were red. Among the attributes, the qualification of 3 improved, 1 degraded and 13 did not change in comparison with the preceding year.

- In 2016, the *"Maintenance planning"* indicator improved to yellow after seven years of continuous red qualification, but it degraded to red again in 2017 and 2018. The contributing *"Ratio of performed and planned work orders"* attribute improved to yellow, but the "*Ratio of planned and real length of main overhauls*" attribute degraded to red.
- The qualification of *"Use of load cycles"* attribute remained red, which caused the repeated red qualification of the *"Material condition"* indicator.
- The *"State of the barriers"* indicator became green again, due to the change of "Fuel reliability" attribute from red to green.
- The *"Reportable event"* indicator, being red in the last three years, improved to yellow, due to the improvement of the *"Authority ordered event investigations"* attribute.
- The *"Unplanned shutdowns and power reductions"* indicator degraded to yellow, due to the *"Power reduction due to internal causes"* attribute.
- The *"Repairs"* indicator kept its green qualification.

The indicators of the **area of operational safety** showed continuous improvement. There was no red indicator between 2012 and 2014, as well as in 2016. In 2017, with 7 green indicators and 19 green attributes, this area got the best available qualification. In 2018, 6 green and 1 yellow indicator characterized the area. Among the attributes, 1 degraded and 18 remained unchanged in comparison with the preceding year.

- The *"Actual challenges of safety systems"* has been continuously green since 2006.
- The qualification of the *"Availability"* indicator has been continuously green, since the yellow qualification of the *"Inoperability revealed during test"* attribute in 2014.
- The *"Operator preparedness"* indicator, following its green qualification between 2012 and 2014, became red in 2015 due to *"Number of failed licensing exams"* attribute. It improved to yellow in 2016, then in 2017 it further improved and obtained green qualification again.
- The *"Emergency preparedness"* indicator has been green since 2006.
- The *"Risk during operation"* indicator obtained green qualification in the last three years.
- The *"Risk in analysis"* indicator has been green since 2011.
- The *"Environmental risk"* indicator had been yellow for three years, then it degraded to yellow in 2018.

The area of commitment to safety, in 2018, was characterised by 5 green, 3 yellow and 1 red indicators. The number of red indicators did not change in comparison with the

preceding year, the yellow ones decreased by two, while the number of green indicators increased by two. There were 15 green, 5 yellow and 2 red attributes among those 22 safety attributes that provided basis for the indicators. Among the attributes, 3 improved, 3 degraded and 16 remained unchanged in comparison with the preceding year.

- The *"Deviation from planned state"* indicator, except four years, was red in the last ten years due to the red qualification of the *"Number of modifications of the Operational Limits and Conditions"*. The qualification of the indicator improved to yellow in 2016 and kept this qualification in 2017; however, it became red again in 2018. The *"Temporary modifications"* and the *"Operational instructions"* attributes obtained red qualification.
- The *"Violations of requirements"* indicator is highly dependent on the *"Violation of licensing conditions"* attribute; usually, this attribute worsens the indicator. The indicator improved to yellow in 2016 and kept this qualification in 2018.
- The *"Deviations in the reporting system"* indicator was red in 12 years of the period between 2006 and 2017 (as well as in 2017) and yellow in three years. Improvement was visible in 2018 as the *"Delay in reporting of non-immediate reportable events"* and *the "Delay in the submission of event investigation reports"* attributes improved to yellow. Another attribute typically affecting this indicator, namely the *"Delay in reporting of immediate reportable events"* was green in the last four years, since the reporting requirement was always fulfilled within two hours.
- The *"Radiation protection programme effectiveness"* indicator was yellow in the last two years as a consequence of the yellow qualification of the *"Significantly radiation hazardous work programmes"* attribute.
- The *"Industrial safety programme effectiveness"* indicator remained yellow in 2018, due to the yellow qualification of the *"Workplace accidents"* attribute.
- The *"Human factor"* indicator has been green for three years due to the improvement of the *"Inappropriate condition for working*" attribute.
- The *"Self-assessment"* indicator has been green as of 2007.
- The *"Corrective measures"* indicator was continuously yellow between 2008 and 2014. It became green in 2015, then has turned to yellow again since 2016, due to the yellow qualification of the *"Corrective measures of investigations"* and *"Corrective actions of quality assurance related audits"* attributes.
- The *"Operational experience feedback"* indicator has been green for two years.

The HAEA identifies the critical safety attributes each year. These are those attributes, which are below the unacceptable level for at least three years. In 2018, there was no such an attribute.

Events

In 2018, 18 reportable events occurred, including three immediately reportable events. The number of reportable events showed a decreasing trend in the recent years; with a small fluctuation even in a longer period of time. In 2018, an event with AP1 (Accident Protection) actuation occurred once, in addition to four events with AP3 actuation. Human or documentation errors were identified 12 times by investigations. The authority

determined five events as reoccurring events. Real ECCS (Emergency Core Cooling System) actuation did not occur in 2018, natural phenomenon did not cause any event, and no event related to radiation safety occurred during the year.
Based on the experience gained during recent years, the events and failures in relation to Diesel generators needed emphasis. The most frequently affected system in 2018 was the Diesel generator. Greater attention and the investigation of causes are justified in this area.
The HAEA and its technical support organisation, the NUBIKI, performed the probabilistic safety analysis of the reportable events of Paks Nuclear Power Plant to identify the impact of all the events together and each individual event on the safety of the nuclear power plant. In the reporting period, the calculated core damage frequency values as well as those complemented with the increment meant by the events are still under the regulatory limits. The evaluation of the events showed that most of the events were insignificant from the viewpoint of core damage probability increment. Among the events, the Event No. 2007 was significant from the risk increment point of view, since the associated conditional core damage probability increment exceeded the threshold value of 10^{-6} applied for the identification of precursor events.

It can be stated based on the safety evaluation of the events that the number of reportable events, events entailing AP1 actuation, and of events entailing the inoperability of two safety systems did not change in comparison with 2017. The number of events associated with the Diesel generator, reoccurring events, and of events entailing AP3 actuation decreased. The number of events entailing forced power reductions exceeding 50%, and of events associated with foreign material slightly increased; however, this value was not extraordinary in the view of the last 5-10 years. Every event was classified as INES 0, without safety significance. Events entailing the violation of the Technical Specifications or ECCS operation did not occur since 2014. AP1 did not occur during operation since 2015. There was no radiation safety related event in 2018. Both the ratio and the number of events induced by human errors slightly decreased in comparison with the preceding year. The licensee submitted each and every regular report in due time.
It is a continuous expectation of the authority towards the licensee to strengthen its efforts towards safety commitment to eliminate deviations, and to maintain and further enhance the safety level, including a strong safety culture.

Licensing
The HAEA, in the frame of its public administration proceeding and oversight activity associated with nuclear safety of nuclear facilities, made 184 regulatory decisions in 2018, including 100 conclusive decisions, 83 procedural decisions, and 1 preliminary co-authority opinion.
Among the decisions, 141 decisions were related to Units 1-4 of Paks Nuclear Power Plant, 15 to the new units under construction at Paks, 14 to the SFISF, 4 to the BRR and 10 to BUTE INT TR.
The building authority tasks of the nuclear facilities are performed by the HAEA. With the involvement of co-authorities, 26 decisions were made in the field of construction and utilisation licensing. On-site walkdowns were conducted prior to granting licenses for

utilisation, where the representatives of the competent authorities and the licensee took part. Additional 60 conclusive decisions were made in relation to licensing connected to practices of civil engineering profession.
The number of conclusive decisions related to Paks Nuclear Power Plant is nearly identical with the number in 2017. Majority of the decisions were made necessary by the tasks and modifications entailing significant safety improvement, inspection of equipment and system components, elimination of deviations revealed during maintenance, replacement to more modern and new types, reconstructions, renewals and equipment modernisations.

Inspection
In 2018, 487 inspections were recorded at Paks Nuclear Power Plant, including 352 on-site inspections, 74 delivery-acceptance, 36 clarifications of cases and 25 times the acceptance of the Documentation Substantiating the Operation After Modification. On-site inspections consisted of:

- Periodic tests of safety equipment and systems,
- Monitoring of operating conditions of the units and general technical conditions at the facility,
- Targeted inspections of modifications,
- Inspection of activities performed during main overhauls of the units.

During the inspections, there was no need for any immediate action or intervention to the operation. Nuclear safety inspectors inspected 181 times the adequacy of the preliminary safety evaluation of the planned modifications (inspection records are not made about these inspections, they are recorded in an individual database). Many inspection records were made in relation to the TSR and the PSR, and 2 inspections were conducted in connection with event investigations.

In accordance with the annual regulatory review programme, the HAEA performed a comprehensive inspection at the Paks Nuclear Power Plant in 2018, in the fields of radioactive waste management and safety analyses. Its results were recorded in 4 inspection reports. During the comprehensive inspection, the HAEA did not identify any non-compliance within the scope of the inspection; however, it took 12 comments. Out of the comments taken during the inspection, the HAEA prescribed 3 observations as tasks in the conclusive decision concluding the inspection, while the good practices were recognized as safety improving measures.

The HAEA inspected the documentation of the safety engineering reviews of pressure retaining systems 43 times, including the review of several hundred documents. The documents included the passports of pressure retaining equipment, inspection reports serving as supporting documents of records in the passports, and licenses related to these examinations.

Nuclear Emergency Response

In accordance with the provisions of the Nuclear Safety Code (hereinafter referred to as NSC) issued as the annex to the Govt. decree 118/2011. (VII.11.) on the nuclear safety requirements for nuclear facilities and on the associated regulatory activities (hereinafter referred to as Govt. decree 118/2011.), Paks Nuclear Power Plant shall conduct a full scale nuclear emergency response exercise with the participation of the entire Emergency Response Organisation (hereinafter referred to as ERO) and shall provide opportunity for the participation of off-site contributing organisations. This exercise was held in November 2018 by the Paks Nuclear Power Plant. An earthquake was the initiating event of the exercise, and as a consequence, the total loss of the national electric network was postulated. As a consequence of the total loss of power, an SCR drive mechanism ruptured during the shutdown of Unit 2 and then an SCR rod exploded out (reactivity transient) and the SCR drive penetrated the protective dome above the reactor. The ERO of Paks Nuclear Power Plant excellently performed its tasks and adequately informed the off-site organisations about the occurrences.

As an outcome of the Targeted Safety Re-assessment performed after the Fukushima accident, Paks Nuclear Power Plant is prepared for the management of nuclear emergencies affecting more units on the site simultaneously. During Severe Accident Management (SAM) exercises, the ERO demonstrated that it could respond to multi-unit emergencies.

Besides, Paks Nuclear Power Plant conducted an unannounced alerting drill for the duty officers of the ERO.

Organisational Factor

An organic part of the inspection and evaluation activities of the HAEA is the oversight of the licensee's safety culture, training, suppliers, utilization of external experience, and the review of inspections conducted together with co-authorities. During the regulatory activities in relation to the assessment of human factors, no problem that could fundamentally jeopardise safety was identified by the HAEA, and there was no need to order any immediate regulatory measure.

2.2 Spent Fuel Interim Storage Facility

Based on the evaluation of safety performance of the SFISF in 2018, the HAEA concluded that the **facility operated in compliance with the legal requirements**. The operation of the facility **did not mean a health risk increment for the employees of the SFISF and the public**. The low value of occupational radiation exposure further decreased, the radioactive release was also very low, much lower than the regulatory limit values. The facility was operated in compliance with the regulations and the OLC.

It can be stated that the nuclear safety level of the nuclear facility in 2018, in comparison with 2017, increased in the area of „Smooth operation", while remained green in the areas of „Operation with low risk" and „Operation with a positive safety attitude".

Figure 2.2-1: SFISF bird view (source: http://www.rhk.hu/images/letesitmenyeink/kkat-tavlati-kep.jpg)

In 2018, the safety performance indicator system (SPIS) of the SFISF was composed of 10 green indicators. Among the attributes, all of the 19 were green.

The **area of smooth operation attributes** was in the unacceptable range due to one attribute in 2017. In 2018, the *"State of systems and equipment"* indicator became green again as a result that the qualification of the *"Adequate planning of fuel loading period"* attribute improved from red to green. The yellow qualification of the *"Installed radiation protection monitoring system"* attribute appeared once in 2014, did not return; thus, the attribute was green again. The other indicators of the area, the *"Storage characteristics"* and *"Events"* have been continuously green for years.

The **area of operation with low risk** obtained good qualification, all of its attributes were in the green range. The *"Risk"* indicator improved from yellow to green in 2017. The other indicator of the area, *"The Environmental risk"* got green qualification for years.

In the **area of operation with a positive safety attitude** the qualification of the *"Violation of requirements"* attribute of the *"Human factor"* indicator remained green; each indicator of the area was in the green range. The *"Independent internal audits"* attribute of the *"Striving for improvement, self-assessment"* indicator kept its green qualification in the third year after its red qualification in 2015. The other indicators of the area, the *"Experience feedback"*, the *"Radiation programme effectiveness"* and the *"Industrial safety programme effectiveness"* were continuously green for years.

Events

In 2018, reportable event did not occur; however, 4 events occurred under indirect reporting obligation.

Licensing

The HAEA made four regulatory decisions related to the SFISF in 2018. One conclusive decision for the closure of the Periodic Safety Review of SFISF in years 2017-2018, one for the construction license for the Emergency Control Centre of the Physical Protection Centre located at the operational area of the SFISF, one for the temporary exemption from requirements affected by the modifications of the Govt. decree 118/2011 in 2017 and 2018, and one for the operating license for the extended SFISF with Chambers 1-24.

Completion of the Periodic Safety Review of the SFISF

In line with Article 9 (3) of the Act on Atomic Energy, a periodic safety review shall be performed at nuclear facilities (so at the SFISF) and radioactive waste repositories in order to comprehensively analyse and assess the compliance with the relevant safety requirements and the extent of risk. The review shall be performed, once every ten years, based on the provisions established in the Govt. decree 118/2011. containing the detailed requirements, taking into account the relevant experience gained during the last ten years from the operation of the facility, and other domestic and foreign application of atomic energy, new safety related information, and the newly published international recommendations. The last periodic safety review of the SFISF was completed in 2008, and it determined the schedule of the subject review in 2017-2018. Regarding the review, the HAEA published its recommendations in Guideline F1.39 in March 2017.

In the first stage of the review, the licensee (PURAM Ltd) thoroughly analysed and assessed the safety of the SFISF, taking into account December 31, 2016 as the reference date. The periodic safety review report including the outcomes of the work, the revealed deviations and the related programme of safety improvement measures were submitted to the HAEA on November 30, 2017. The conclusive decision RHKK-HA0030 closing the review was issued on October 2, 2018 after the authority review of the report with the

involvement of the competent environment and nature protection (Pecs Regional Office of the Baranya County Government Office), fire protection (Paks Disaster Management Office of the Tolna County Disaster Management Directorate) and disaster management (MoI National Directorate General for Disaster Management) co-authorities. The HAEA prescribed the implementation of safety improvement measures to deal with safety related deviations in the conclusive decision.

Altogether 14 safety improvement measures were required to be executed with various deadlines. 12 out of them related to the deviations identified by the licensee and 2 to those identified by the HAEA. The deadlines for executions extend, depending on the scope of the task to be executed, from December 31, 2018 to March 31, 2022. In general, the deviations have administrative nature, including the revision of the final safety analysis report (FSAR) of the SFISF and the substantiating safety analyses and their completion from different points of view. Furthermore, 2 prescribed actions relate to the review and development of internal management documents.

Granting the construction license for the Emergency Control Centre of the Physical Protection Centre located at the operational area of the SFISF

The PURAM Ltd submitted its application for the subject construction license on June 27, 2018. The construction license application was based on the recommendation provided in Item 1 of the final report of the physical protection review performed in the frame of the International Physical Protection Advisory Service (IPPAS) mission in relation to the structure of the guard centre.

Based on the documents submitted with the application and during the licensing proceeding, the HAEA was able to evaluate the license application, and it concluded that planned structures, constructional and technical solutions were in compliance with the relevant legal and regulatory requirements, professional rules and provisions. The fire protection co-authority involved into the licensing proceeding (Paks Disaster Management Office of the Tolna County Disaster Management Directorate) gave its consent to granting the license. The HAEA granted the construction license having the deadline of December 31, 2020 in its conclusive decision RHKK-HA0032 issued on October 15, 2018.

Assessment of the compliance with the 2017 and 2018 amendments to the Govt. decree 118/2011., and exemption of fulfilment of certain requirements until a specified deadline

In 2017 and 2018, the Govt. decree 118/2011. (VII.11.) on the nuclear safety requirements for nuclear facilities and on the associated regulatory activities was amended several times and supplemented with new requirements. In line with Article 40/E of the Govt. decree, the PURAM Ltd. reviewed its compliance with the new and amended requirements, then submitted a report to the HAEA that determined the identified deviations together with the corrective measures decided to deal with them. At the same time, it submitted an application regarding the period of execution of the corrective actions. The identified deviations had administrative nature; most of them were associated with internal SFISF related management documents and procedures of the PURAM Ltd.

The HAEA assessed the submitted report, and then determined that the identified deviations did not have unacceptable safety impact until the end of the period requested for their elimination. Accordingly, it approved the application and prescribed the execution of the corrective actions in its conclusive decision RHKK-HA0033 issued on December 6, 2018.

Granting the operating license for the extended SFISF with Chambers 1-24

On June 12, 2018, the PURAM Ltd. submitted to the HAEA its application to obtain the operating license for the extended SFISF with Chambers 1-24 that initiated the regulatory review procedure. Two aspects justified the submission of the application. On the one hand, the operating license of Chambers 1-20 expired on November 30, 2018, and according to the relevant legal provisions, a new operating license had to be obtained after the expiry of the operating license. On the other hand, the commissioning of the newly built Chambers 21-24 was performed in the beginning of 2018, based on the license RHKK-HA0020 granted by the HAEA in 2017, and their operation required an operating license.

The license application was substantiated with the chapter on commissioning of Chambers 21-24 of the safety report of the facility, the commissioning work programme, the evaluation of the commissioning and the required internal management documents. The intention of PURAM Ltd was to demonstrate that the SFISF could be safely operated. During the proceeding, the HAEA requested the submission of additional documents to further clarify the case.

As a part of the proceeding, advertised on many fora, a public hearing was held on October 9, 2018 at the Local Government of Paks town, in order to allow the public being aware of the relevant details of the case and sharing its opinion, and gaining answer to its questions from the representatives of the competent authorities. Questions or comments were not received as the event did not attract the public.

The HAEA continuously overviewed and inspected the extension of the SFISF with Chambers 21-24 in its each life cycle stage, and licensed as it was necessary. During its activity, the HAEA did not reveal any circumstance that could hinder the granting of the operating license. The co-authorities involved in the proceeding (the Regional Office of the Baranya County Government Office in its environmental protection and nature conversation competence and the Directorate General of the National Disaster Management Organisation) gave their consents to granting the license. Accordingly, the HAEA could assess the application and then licensed the operation of the entire facility with Chambers 1-24 until March 2, 2030 in its conclusive decision RHKK-HA0035 issued on November 27, 2018.

The records documenting the licensing proceeding, the advertisement of the public hearing and the information of the event, together with the decision of the HAEA made in the proceeding (operating license) were all made accessible at the office of the Local Government of Paks Town, the website of the HAEA and its advertisement post, and on the portal of public administration information.

Inspection

In 2018, the HAEA conducted 8 inspections at the SFISF, out of them 6 were safety related and 2 physical protection related. The HAEA paid special attention to the inspection of the active test (first storage of spent fuel assemblies to the storage tube) performed during the commissioning of the newly built Chambers 21-24 of the SFISF and the annual maintenance. Besides, the authority followed the assessment of the condition of the civil structures of the SFISF in 2018, and performed a radiation protection inspection at the facility, according to the annual inspection plan. In addition, two inspections aiming at information gathering were conducted during the operating licensing proceeding of the extended facility with Chambers 1-24 and in connection with the modification of certain camera systems of the refuelling machine. Several inspections determined in the 2018 annual inspection plan were rescheduled to next years in line with the rescheduling of the activities to be inspected (construction of Chambers 25-28, re-storage of assemblies and related to lifting machines).

Every inspection was successfully completed; immediate regulatory interventions did not become necessary in any case. The HAEA identified non-compliances in the case of two inspections, as follows:

- During the inspection of the active tests of the commissioning process, the direct phone connection between the refuelling machine operator and the control room was disrupted, several false error indications appeared on the refuelling machine, the accepted range of storage tube vacuum (as specified in an internal management document) was exceeded. These deviations were taken into account by the HAEA during the operation licensing proceeding. Considering the decided corrective action (for the disruption of phone communication), the lack of safety relevance (false error indications), and the administrative nature of the deviation (exceeding of the acceptance range of vacuum), the deviations did not prevent granting the operating license.
- During the inspection of the camera systems of the refuelling machine, the HAEA revealed that the modification aiming at ensuring the independence between certain camera systems prescribed in HAEA conclusive decisions was not executed. The evaluation of this deviation is still on-going at the HAEA. Nevertheless, it can be stated at the date of this report that the current version of the relevant requirement that was modified during the 2018 amendment to the Govt. decree 118/2011. (the former version of which provided the basis of the prescription) is complied with by the current (unmodified) state of the camera systems.

Nuclear Emergency Response

In the case of an emergency at the SFISF, the ERO of Paks Nuclear Power Plant performs the necessary tasks.

According to the provisions of the NSC, the SFISF shall conduct a nuclear emergency exercise with the involvement of the entire ERO once in every two years. This exercise was

not due in 2018. According to the exercise plan of the SFISF, such an exercise will be conducted in May 2019.

Organisational Factor

The HAEA inspected the training system based on its annual inspection plan. A representative of the HAEA participated in every authority licensing exam, who recorded his/her experience in inspection reports. It was concluded during the inspections that the organisation, conduct and documentation of the examinations were performed according to the effective provisions. The experience of the examinations was evaluated, and actions were implemented, as required. In line with the internal regulations, the professional areas of the licensee might propose different training topics. The review of the training material was performed in line with the internal regulations. In summary, it can be stated that such an issue was not identified which might jeopardise safety, thus immediate authority intervention was not justified.

2.3 BUTE INT Training Reactor

Based on the evaluation of the safety performance of the BUTE INT TR in 2018, the HAEA judged that the **facility operated in compliance with the legal requirements**. The operation of the facility **did not mean health risk increment for the employees of the BUTE INT TR, the students and training participants and the public**. The occupational radiation exposure was as low as in the recent years. The radioactive release was also very low, much lower than the regulatory limit values. The reactor was operated in compliance with the regulations and the operational limits and conditions specified in the TS.

It can be summarised about the safety performance that the area of „operation with low risk" is continuously good for years, the area of "smooth operation" and "operation with a positive safety attitude" area moved from the authority acceptable range and the range that requires authority action (in 2017) and reached good qualification.

Figure 2.3-1: Budapest University of Technology and Economics, Training Reactor (Source: https://www.bme.hu/sites/default/files/hirek/20150603_SzatmaryZ_06.JPG)

In 2018, the SPIS of the BUTE INT TR consisted of 12 green indicators. Among the safety attributes, all of the 24 were green.

Three indicators of the **area of smooth operation**, namely the *"Operating performance"*, the *"State of systems and equipment"* and the *"Reportable events"* indicators have kept green

qualification for years. The stable green qualification of the *"State of safety barriers"* indicator changed to yellow due to the yellow qualification of the *"primary cooling circuit integrity"* attribute in 2017, but the attribute turned to green again in 2018, thus the indicator became green as well.

In the **area of operation with low risk**, the *"Safety systems, equipment"* indicator has kept its green qualification, currently for four years since 2015, because the *"Number of safety protection system failures"* attribute became green again based on the data of 2018. The other indicators of the area, the "*Releases*" and the *"Risk"* has been getting green qualification for years.

In the area of **operation with a positive safety attitude**, the *"Human factor"* indicator became green again due to the improvement of the *"Number of violations of the requirements"* attribute from red (in 2017) to green. The other indicators of the area, the *"Striving for improvement, self-assessment"*, *"Operating experience feedback"*, *"Radiation protection programme effectiveness"* and *"Industrial safety programme effectiveness"* indicators have been continuously green for years.

Events

An event entailing safety system actuation, violation of the TS or operation under the effect of the TS, or an event induced by a natural phenomenon, a radiation safety related event or a human induced event did not occur at the facility in 2018. One reportable event occurred in connection with a contact failure of an electronic component.

Licensing

The HAEA made 10 authority decisions regarding the BUTE INT Training Reactor in 2018. The authority issued 3 conclusive decisions and 6 procedural decisions in relation to the workplace radiation protection rules. The HAEA, in another conclusive decision, modified the deadlines for two tasks determined in the Periodic Safety Review closing conclusive decision issued in 2017.

Inspection

The HAEA performed 6 nuclear safety inspections at the BUTE INT TR in 2018. In line with its annual plan, the HAEA inspected the maintenance activities, the condition of the building, and the proper application of radiation protection rules during the educational activity performed at the BUTE INT TR. In addition, the representative of the HAEA participated in the authority examinations.

The inspection of maintenance of the BUTE INT TR performed in January, in addition to the inspection of the significant activities performed in January (condition of the replaced primary circuit valves, replacement of bearings of the irradiation tunnel, commissioning of a new Radiation Protection Monitoring System (RPMS), covered the review of the maintenance contracts from nuclear safety point of view, and the evaluation of the experience gained regarding the renewal of the nuclear measuring chains. Besides the difficulties of the purchase of the sump pump, the inspection did not reveal any deviation.

The on-site inspection performed to inspect the significant actions of the summer maintenance of the facility (primary water circuit, nuclear measuring chain and RPMS maintenance) and to further evaluate the experience gained regarding the renewal of the nuclear measuring chains concluded that the RPMS did not completely fulfil its tasks. Based on the authority assessment, the licensee ensures the fulfilment of tasks with temporary measures. The problem will be completely eliminated by the commissioning of the new RPMS, which is currently on-going.

During the building oversight status inspection, the HAEA checked the basement level, observed the building of the facility from outside and inspected the repair of the lightning installation. During the walkdown in the building, the traces of past and recent flooding and doming of the floor cover were observed. In order to follow the evolution of these conditions, another on-site inspection was performed including the walkdown in the basement of the BUTE INT TR and the reactor hall; the HAEA observed no improvements during the inspection, thus it required an action plan for the management of the deviation.

During the inspection of the educational activity of the Training Reactor from radiation protection point of view, the HAEA revealed 3 safety relevant deviations: not the latest version of the WPRPR or its extract was used everywhere, the control panel of the operating crane was left unattended with foreign materials on it, and student access was permitted without checking the occurrence of radiation protection training. The authority obliged the licensee to eliminate these deviations in a letter, who executed the necessary measures without delay.

The HAEA inspected the authority examinations of the operating personnel of the Training Reactor. The examinations were conducted according to law, deviations were not revealed by the authority.

As a summary, it can be stated that the authority did not identify any fundamental problem jeopardising safety; ordering of any immediate regulatory actions was not justified. Upon request of the HAEA, the deviations observed during inspections were either eliminated by the licensee or an action plan was developed for their management.

Nuclear Emergency Response

The BUTE NTI Training Reactor shall conduct, biannually, a full scale nuclear emergency response exercise with the participation of the entire Emergency Response Organisation, with the involvement of off-site emergency response organisations. This exercise was not due in 2018. The exercise will be conducted in the second half of 2019.

Organisational Factor

Authority certificate is required to act in duty operator, duty assistant operator and duty radiation protection officer positions. The authority examination has to be performed in line with the regulation prepared by the licensee and approved by the nuclear safety

authority. In 2018, 1 radiation protection officer and 1 operator took successful authority exam.

The HAEA inspected the training system based on its annual inspection plan. A representative of the HAEA participated in every authority licensing exam, who recorded his/her experience in inspection reports. It was concluded during the inspections that the organisation, conduct and documentation of the examinations were performed according to the effective provisions. The experience of the examinations was evaluated, and actions were implemented, as required. The review of the training material was performed in line with the internal regulations. In summary, it can be stated that such an issue was not identified which might jeopardise safety, thus immediate authority intervention was not justified.

2.4 Budapest Research Reactor

Based on the evaluation of the safety performance of the BRR in 2018, the HAEA confirmed that **the facility operated in compliance with the legal requirements**. The operation of the facility **did not mean a health risk increment for the employees of the BRR and the public.** The occupational radiation exposure was as low as in the recent years. The radioactive release was also very low, much lower than the regulatory limit values. The reactor operated in compliance with the regulations and the OLC.

Based on the qualification of the safety performance indicators, it can be concluded that in 2017 the warning qualifications in the area of "smooth operation" indicated an increasing number of technical issues caused by ageing of the research reactor. In 2018, the value of each indicator and attribute was green. Accordingly, both the licensee and the authority shall pay more attention on the ageing management activities in order to prevent the appearance of failures. The area improved compared to the level of the preceding year with 2 improving indicators. The "operation with low risk" area held its flawless performance. Due to the warning qualifications in the area of "operation with a positive safety attitude" the licensee has to improve the compliance with regulatory requirements and decrease the human error induced reportable events, while the authority has to pay special attention to the enhancement of the level of safety culture within the organisation of the Licensee. The third area kept the level of the preceding year with 2 improving and 2 degrading indicators.

Figure 2.4-1: Budapest Research Reactor (source: http://www.innoportal.hu/wp-content/uploads/2016/08/budapesti-kutatC3B3reaktor.jpg)

In 2018, the SPIS of the BRR consisted of 2 yellow and 10 green indicators. Among the safety attributes, there were 2 yellow and 28 green. Comparing to 2017, the qualification of 4 attributes degraded from green to yellow, while 2 attributes degraded from green to yellow.

In the main evaluation **area of smooth operation**, 2 attributes turned out of the warning range and improved to green. The "*Nuclear measurement chains*" attribute of the *"State of systems and equipment"* indicator improved from yellow to green. Between 2010 and 2013, an event affecting the status of the measurement chains occurred every year, out of which two fell under reporting obligations. In 2015 3 failures occurred, 2 out of which were reportable events. One failure related to the measurement chains in 2016, which was repaired by card replacement.
Two failures occurred in 2017, a measuring chamber and the connected measuring card were replaced. The failures indicate, despite the maintenance activity, the aged condition of the system. A part of the used parts (e.g. Z80 microprocessor ad its interfaces) represents the technology of the 80's. Despite that, the installed and spare cards were checked by a professional service provider in the frame of the corrective measures decided in 2015, and the critical elements of the CPU card were replaced, the reconstruction of certain elements of the instrumentation and control system is unavoidable in the future.
The qualification of the *"Unplanned shutdowns and power changes due to internal causes"* attribute of the *"Operating characteristics"* indicator improved from yellow to green.
Regarding the other indicator of the area, it can be stated that the only one attribute of the *"Events"* indicator, namely the *"Reportable events"* attribute has been continuously green for years due to its value below the criterion level. However, due to the degrading trends of events, these criteria should be reviewed.

All indicators in the area of **operation with low risk**, namely the *"Releases",* the "S*afety systems and equipment"* and the *"Risk"* have been obtaining green qualification for years.

Special attention should be paid to the *"Violations of requirements"* attribute in the area of **operation with a positive safety attitude**. The attribute got red qualification in 2013, and then green in 2014 and 2015. As a consequence of 2 lately fulfilled requirements in 2016, the attribute became red again in 2016. The qualification of the attribute improved to yellow in 2017; 1 deadline violation occurred during the fulfilment of legal obligations. The attribute improved to green again in 2018.
Another attribute of the *"Human factor"* indicator, namely the *"Human induced events"* also improved from yellow to green.
The indicator *"Striving for improvement, self-assessment"* degraded to yellow due to the degradation of the "*Independent internal audits*" to yellow because of deficient documentation of audits.,
The indicator *"Radiation protection programme effectiveness"* became yellow due to the degradation of *"Radiation protection related event reports"* to yellow.
The *"Operating experience feedback"* and the *"Industrial safety programme effectiveness"* indicators have been maintaining the green value for years.

Events

In 2018, 2 reportable events occurred at the BRR. During an event, a temporary shutdown occurred due to a computer virus attack. In the other event, cracks were detected at the bottom part of one fuel element.

Although less event occurred in 2018 in number compared to the preceding year (5 events), the BRR is under increased regulatory oversight due to the otherwise known staff and safety culture related problems. The quality of the event reports in variably low.

Licensing

The HAEA concluded 4 regulatory decisions in association with the facility in 2018. In the proceedings targeted the modification of the Operational Limits and Conditions document of the BRR, the authority made one procedural decision and one conclusive decision. Furthermore, it terminated in a conclusive decision its type C event investigation launched in 2017, and issued a procedural decision requiring supplementation in the procedure started for the submission of the BRR to demonstrate the compliance with the Govt. Decree 118/2011. (VII.11.) entered into force on 10 April 2018.

Inspections

In 2018, the HAEA conducted 9 nuclear safety inspections at the Budapest Research Reactor. In accordance with the annual inspection plan, the HAEA inspected the annual maintenance actions, the activities associated with condition maintenance of civil structures, progress of manufacturing of the spare control rod and application of radiation protection rules. Furthermore, beyond the annual plan, it conducted revealing inspections corresponding to two events. During one of the inspections, the authority examined the fulfilment of corrective actions after the fuel swap event in 2017, while during the other it investigated the circumstances of the event caused by computer virus infection reported in 2018.

During the radiation protection inspection of experimental works in the BRR and of the use of radiation sources, the HAEA identified two smaller deviations in the area of accessibility of the most recent version of the WPRPR and its training for the employees of external contractors. The HAEA called the licensee for action in a letter, who eliminated the deviations.

The authority conducted two inspections in 2018 corresponding to condition maintenance and facade reconstruction of Building 10, during which it reviewed the documentation justifying the delimitation of the construction area and inspected its implementation, inspected the condition of the building and the performed condition maintenance works, the ageing management activities and the digitalization of the construction plan documentation of Building 10. The authority identified smaller deviations, the elimination of which was requested from the licensee in a letter.

Concerning the summer maintenance tasks of the BRR, the authority conducted inspections in 3 cases for reviewing the final phase of general maintenance of the primary circuit, completion of capacity tests of the battery sets and the power control measurement chains and the respective reconstruction plan. It also reviewed the operating experience gained during the secondary pipeline replacements and operation of the modified sealing of the Tuflin valves, furthermore it inspected the documentation of the maintenance work processes (work instructions, measurement records). The authority did not reveal any deviations during the inspection of maintenance activities.

The regulatory inspection conducted for confirmation of compliance of manufacturing technology of spare control rods of the BRR did not reveal any deviations. Based on the documentation reviewed the raw materials and the welding technology satisfy the quality requirements assigned to the original absorbent rods. The replacement and provision of spare rods may begin after the appropriate expertise is obtained and successful nuclear tests are completed.

The HAEA conducted a revealing inspection corresponding to a reported event involving virus infection of the BRR radiation protection measurement and monitoring system computer. Two further actions were required from the licensee based on the information collected during the inspection and review of the event investigation report.

In relation to the fulfilment of corrective actions taken after the fuel swap event in 2017, the HAEA conducted a field inspection of the core rearrangement process. The inspection did not reveal any deviation.

The authority inspected the authority licensing exams of the BRR operational staff. The exams were conducted according to the legal provisions, no deviation was revealed.

In summary, it can be stated that such an issue was not identified which might jeopardise safety, thus immediate authority intervention was not justified.

Nuclear Emergency Response

The Budapest Research Reactor shall conduct, biannually, a full scale nuclear emergency response exercise with the participation of the entire Emergency Response Organisation, with the involvement of off-site emergency response organisations. The next of such exercises took place in 2018. During the exercise a stroke of lightning originating from extreme meteorological conditions affected the electrical network that cause a temporary trip of the dose rate measurement network. In accordance with the Emergency Preparedness and Response Plan (EPRP) the emergency response organization was convened that ordered for environmental monitoring and requested assistance from the Budapest Inspectorate of the Disaster Management. The disaster management organization deployed a mobile monitoring vehicle to the scene. The exercise was successfully completed by the involved personnel.

Organizational Factors

The HAEA inspected the training system based on its annual inspection plan. It was concluded during the inspections that the organisation, conduct and documentation of the examinations were performed according to the effective provisions. The experience of the examinations was evaluated, and actions were implemented, as required. In line with the internal regulations, the professional areas of the licensee could propose different training topics. The review of the training material was performed in line with the internal regulations. In summary, it can be stated that such issue was not identified which might jeopardise safety, thus immediate authority intervention was not justified.

2.5 National Radioactive Waste Repository (NRWR, Bátaapáti)

Figure 2.5-1: Operation hall of the technology building (Source: http://www.rhk.hu/images/sajto/nrht-felszin-technologiai-epulet-uzemcsarnok.jpg)

Regulatory Oversight of Radioactive Waste Repositories

In 2018, after the coming into force of Govt. decree 155/2014., the HAEA continued its regulatory activity over the radioactive waste repositories that started in the second half of 2014. Accordingly, the development of guidance (guidelines) on the method of compliance with the nuclear safety requirements established in the Govt. decree 155/2014. continued. Further six guidelines entered into force in 2016 in the following topics: "Event reporting of radioactive waste repositories", "Periodic Safety Review of the Radioactive Waste Treatment and Disposal Facility (RWTDF)", "Guidance on the content and formal requirements for the Safety Report Substantiating the Operation of radioactive waste repositories", "Guidance on the content and formal requirements for the Safety Report Substantiating the Construction of radioactive waste repositories", "Management system of radioactive waste repositories", and "Assessment of the safety culture and utilisation of its results at radioactive waste repositories". In 2017, the HAEA published a new guideline "Safety classification of systems, structures and components of Hungarian radioactive waste repositories".

In 2018 the authority published the guidelines "Methodology to conduct INES classification for nuclear and radiological events" that also relates to radioactive waste repositories.

The guidelines provide regulatory recommendations for the fulfilment of the legal requirements for radioactive waste repositories.

Based on the evaluation of the safety performance of the NRWR in Bátaapáti in 2018, the HAEA determined that **the facility operated in compliance with the legal requirements**. The operation of the facility **did not mean a health risk increment either for the employees of the NRWR or the public**. The occupational radiation exposure was as low as in the recent years. The radioactive release was also favourably low, much lower than the regulatory limit values.

Events

In 2018, 2 reportable events (one caused by natural phenomenon and another radiation safety related event) occurred during the operation of the NRWR.

In the process building, during an incident of the L-A-33/10 ton crane, when the crane stopped during the placement of the transport frame containing the waste package. After revealing the failure, the replacement of the failed component was performed.
Due to the failure of dose rate measurement of the type “A” environmental monitoring station identified as Zsibrik A1/OSJER - HU4301, the dose rate measurement probe of the station was put out of operation to avoid continuous generation of faulty measurement results and alarms. While investigating the failure and repairing the equipment, an accredited device was used to perform on-scene measurements twice a day. Subsequent to refreshing the contacts of the connectors of the units and replacement of the NEMP filter the equipment was taken back to operation.

Licensing

In 2018, in connection with the NRWR, based on the submitted documents, the HAEA commenced the safety review of one planned modification in the subject of modification of the tank station collecting waste water at the cellar level of the NRWM process building. Under the effect of Govt. decree 487/2015. (XII.30.) the authority approved the Workplace Radiation Protection Rules of the NRWM. The HAEA also granted the authority licence for the modification of the NRWM Operational Limits and Conditions document under the effect of Govt. decree 155/2014. (VI.30.).

Inspections

In 2018, the HAEA performed 9 on-site inspections at the NRWR documented in inspection records. Out of them 2 inspections were related to realised modifications, while 7 to the operation of the repository. Immediate action, intervention affecting the operation was not necessary during the inspections.

Nuclear Emergency Response

According to the law, the radioactive waste repositories shall conduct, at least biannually, a nuclear emergency response exercise with the participation of the entire organisation, with the involvement of off-site emergency response organisations.

Such a pre-announced emergency response exercise was due in 2018 in the NRWR. The facility conducted a two-stage exercise consisting of the alert of the ERO and a table top exercise of the nuclear emergency preparedness and response plan. Both exercises was qualified as „appropriate".

Organizational Factors

Decree 55/2012 NFM of the minister of national development on *„Special professional training and retraining of employees employed in a nuclear facility and the persons authorized to conduct activities in relation to nuclear energy"* determines the job positions bound to regulatory licence. The training activities meant to obtain the regulatory licences can be performed after amending and entering into force of the decree 55/2012 NFM in 2019.

The training and qualification activities of the subject year adequately ensures the maintenance of the skills of the professional staff to safely operate the NRWM. Experience obtained during HAEA inspections also supported this conclusion.

On 31 January 2018, the PURAM sent to the HAEA its amended internal rules related to qualifications required for fulfilling positions important to safety, and the process of granting and renewing regulatory licenses. The ruling document was incorporated into the integrated management system.

2.6 Radioactive Waste Treatment and Disposal Facility (RWTDF, Püspökszilágy)

Figure 2.6-1: Bird view of the Radioactive Waste Treatment and Disposal Facility (Source: http://www.rhk.hu/images/sajto/rhft-madartavlat.jpg)

Regulatory Oversight of Radioactive Waste Repositories

Based on the evaluation of the safety performance of the RWTDF, the HAEA determined that **the facility operated in compliance with the legal requirements**. The operation of the facility **did not mean a health risk increment either for the employees of the RWTDF or the public**. The occupational radiation exposure was as low as in the recent years. The radioactive release was also very low, much lower than the regulatory limit values.

In 2018 the authority published the guidelines "Methodology to conduct INES classification for nuclear and radiological events" that also relates to radioactive waste repositories.
The guidelines provide regulatory recommendations for the fulfilment of the legal requirements for radioactive waste repositories.

Events
Reportable event (event induced by a natural phenomenon, radiation safety related event, etc.) did not occur at the RWTDF in 2018.

Licensing
In 2018, in connection with the RWTDF, based on the submitted documents, two regulatory licensing proceedings were initiated under the effect of the Govt. decree 155/2014. (VI.30.). A modification of the operation license of the RWTDF and a modification of the waste management processes to implement the safety improvement actions of the RWTDF were launched. An authority proceeding was initiated under the effect of the Govt. decree 487/2015. (XII.30.), which was aimed at the approval of the WPRPR of the RWTDF.
In addition, in 2018, the licensing proceeding regarding the review of safety area of the RWTDF based on the Govt. decree 246/2011. (XI. 24.) on safety area of nuclear facilities and radioactive waste repositories, initiated upon the request of the PURAM Ltd was completed.

Inspection
In 2018, the HAEA performed 16 on-site inspections at the RWTDF documented in inspection records. Out of them 5 inspections were related to realised modifications, and 11 to the operation of the repository. Immediate action or intervention to the operation was not necessary during the inspections.

Nuclear Emergency Response
According to the law, the licensees of radioactive waste repositories shall conduct, at least biannually, a nuclear emergency response exercise with the participation of the entire organisation, with the involvement of off-site emergency response organisations. In 2018, the RWTDF conducted a two-stage exercise consisting of the alert of the ERO and a table top exercise of the nuclear emergency preparedness and response plan and also an emergency management exercise. All exercises were qualified as „appropriate".

Organizational Factors
During inspections, the HAEA reviewed the organisational factors. The authority inspected the management system of the RWTDF and the process to ensure the training and competencies.
During the inspections, the authority did not identify any problem jeopardising the basic safety of the facility, thus immediate regulatory action was not justified.

Decree 55/2012 NFM of the minister of national development determines the job positions bound to regulatory licence. The training activities meant to obtain the regulatory licences can be performed after amending and entering into force of the decree 55/2012 NFM in 2019.
On 31 January 2018, the PURAM sent to the HAEA its amended internal rules related to qualifications required for fulfilling positions important to safety, and the process of granting and renewing regulatory licenses. The ruling document was incorporated into the integrated management system.

2.7 Project for Sustaining the Capacity of Paks NPP

The Paks II. Ltd. is a project company established for the construction of new nuclear power plant units. It became a licensee of the HAEA after the site survey and assessment license was granted to it in 2014. Subsequently, it also obtained the site licence in 2017. Currently the preparation of plans of the new nuclear power plant and its Preliminary Safety Analysis Report is in progress with the involvement of the Russian principal contractor. The next step of Paks II. Ltd. will be the submission of the Construction License Application.

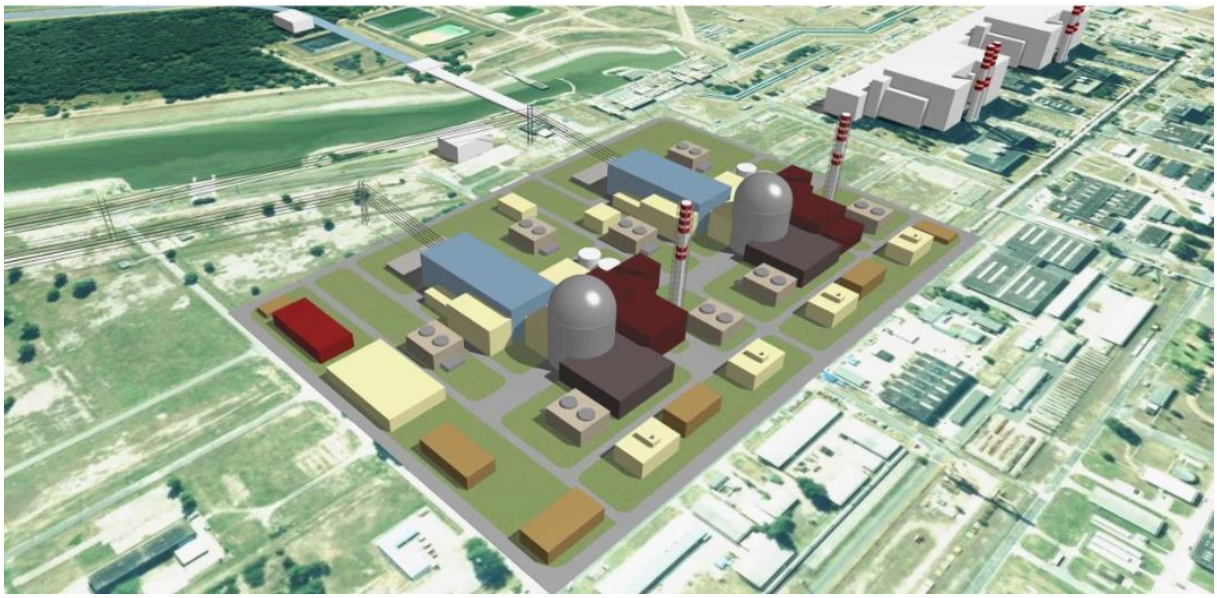

Figure 2.7-1: Design view of the new units (Source: http://www.mvmpaks2.hu/)

Events

One event occurred in 2018 at Paks II. Ltd. During the oversight audit performed at the company Orgenergostroy, the professional staff of Paks II. Ltd were reviewing the plan modification process. Based on the evidence presented by the company under the subject of the audit, the modifications of the reviewed documents were not implemented appropriately. The exact causes and background of and responsibilities for the revealed non-compliances could not be concluded during the audit, therefore the revealed problem was not managed as a non-compliance by the auditors. The HAEA inspectors, being present as observers during the audit, took an inspection record, and after the audit the HAEA management decided that the recorded case should be managed as an event. The causes of the event were originated from the deficiencies of the management system of the supply chain and non-conformances with the internal rules.

After the investigation of the event, Paks II. Ltd took actions to prevent reoccurrence of the event. The HAEA assessed the event in its own investigation and required further actions from the licensee beyond those determined by Paks II. Ltd. The licensee informs the HAEA of the progress of implementation of decided actions on a continuous basis.

Licensing

Construction licenses

In 2018, Paks II. Ltd sent license applications for construction of three buildings to the HAEA. These are the complex of Administration and Service Buildings, the Principal Contractor Office Building, the Investment Office Building and a cafeteria and cooking kitchen for 100 persons. The HAEA granted the construction license for the two office buildings, while for the cafeteria and cooking kitchen for 100 persons Paks II. Ltd. obtained licence in 2019.

The HAEA granted licence for the construction of the Power Plant Investment centre on 2016. In 2018, an application for modification of the license was requested by Paks II. Ltd. After reviewing the submitted documentation, the HAEA granted the modified construction license for the Power Plant Investment Centre.

In 2017, the HAEA, ex-officio, within its own scope of competence, initiated a proceeding regarding "action plan to be developed for the regulatory evaluation of the comprehensive inspection"; the HAEA ordered Paks II Ltd to develop an action for each regulatory comment appearing under a unique identifier in the evaluation report of the comprehensive inspection, and establish an action plan taking into account the executive summary of the evaluation report. The HAEA, with its conclusive decision P2-HA0024, ordered the implementation of the action plan established by Paks II. Ltd.

In 2018, the Paks II. Ltd. submitted an application to modify the deadline of the actions ordered in the HAEA conclusive decision P2-HA0024. The HAEA made a decision in its conclusive decision P2-HA0044 to approve the modification of the deadline of certain actions.

Inspection

The HAEA performed 9 targeted inspections in 2018. During the inspections, immediate actions, intervention to the activities did not become necessary.

Corresponding to the event investigation mentioned in Section 9.1, the HAEA performed more targeted inspections.

During a targeted inspection, the HAEA verified the status of the fulfilment of the conditions of the P2-HA0008 and the P2-HA0024 conclusive decisions. The inspection revealed that the fulfilment of the obligations of the conclusive decisions were in progress, the licensee could mostly keep the deadlines.

The HAEA also inspected the certification process of the contractors and the use of the Supplier Nuclear Qualification (SNQ) database. In the case of contractors, if they perform work having effect on nuclear security, the nuclear qualification is a precondition. Paks II. Ltd. performs the nuclear qualification process based on a pre-defined question list or contracts an external organization perform it. The documents generated during the

certification process are uploaded to the SNQ database, to which the HAEA has access for confirming traceability and retrievability of the corresponding documents.

A geological-geotechnical engineering survey is ongoing at the site performed by the Russian principal contractor and the involved subcontractors to collect data necessary for planning the foundation and other land works. The licensee regularly informs the HAEA of the schedule of works and exact locations of the specific drillings. Since the area under survey is not yet owned by Paks II. Ltd., a consent by the owner (Paks NPP) and the records of handing over of the given field shall be attached to each drilling. During an inspection the HAEA inspectors confirmed that the drilling activity has been performed according to the requirements, the pre-job briefing took place and the documents necessary for the activity is available.

The HAEA inspectors performed a field inspection during the construction licensing of the cafeteria and kitchen for 100 persons to confirm the authenticity of the declarations submitted together with the licensing documents and visited the area for the planned building.

During the inspection of the training arrangements, the HAEA inspectors noted that maintenance of knowledge of the employees is carried out in a planned manner. Training of the process personnel by Paks NPP is based on the training provided according to a frame contract. In the knowledge management system, a MOODLE based platform is used. The licensee does not provide the competencies required from the contractors by training but by auditing the appropriate system and implementation of training. If these are not adequate, the necessary actions taken by the contractors are reviewed by the licensee.

Audits

In 2018, in connection with contractor oversight, Paks II. Ltd. primarily performed the nuclear qualification procedures of the main contractor and its major designer sub-contractors, and of other organisations having role in design related works of the new units. Out of the 20 procedures, 10 were performed with on-site audits, while 10 without on-site audits, via documentation review. The HAEA participated, as observer, in 6 audits in Russia and 4 domestic audits. Following the audits, the licensee granted the qualification to the indicated contractor activities to all but one contractor.

Evaluation of Regular Reports

The conditions of the site permit obliged the licensee to submit, by the 10th day of each month, a summary about the design related activities and the on-site works associated with the construction of the facility, with the content as follows:

a. Activities in progress, postulated activities;
b. Activities performed by the licensee serving for the justification of the adequacy of the design;
c. Supplier qualification and evaluation activities planned, in progress and completed;

d. Revealed non-conformances occurred, safety related events, their evaluation and the corrective actions decided;
e. Changes in the organisation of the licensee;
f. Changes in the number of personnel of the licensee, with particular attention to the changes in management positions;
g. Construction related regulatory proceedings in progress.

The HAEA received 12 status reports in 2018, which were continuously reviewed and evaluated.

I. Annex: Methodology of the regulatory evaluation

Safety has overriding priority above all other aspects during the operation of nuclear facilities. The HAEA annually assesses and evaluates the safety performance of the nuclear facilities and radioactive waste repositories falling under its regulatory competence.

The safety performance is evaluated based on the conclusions of regulatory inspections, operational data, licensing experience, and investigation and analysis of event occurred during operation. Accordingly, the HAEA:

- collects the operational data and examines their trends;
- gains inspection and licensing experience;
- reviews and evaluates the events occurred during the year;
- performs the safety evaluation of events;
- performs the probabilistic based analysis of events,
- pays special attention on the investigation of human induced and reoccurring events;
- comprehensively evaluates the safety performance with the application of the safety performance indicator system.

The HAEA takes into consideration the degree of potential risks during the evaluation of the safety performance of nuclear facilities and radioactive waste repositories being under its regulatory oversight.

The evaluation criteria of safety attributes are determined by the HAEA in a way to take into account the level of safety performance reached by the nuclear facilities and radioactive waste repositories, the national and international experience on the safety of the application of atomic energy, and to facilitate the licensees in the enhancement of their safety performance.

The safety of the operation of the nuclear facilities and radioactive waste repositories is evaluated by systematic numerically quantified characteristics taking account of many aspects, so-called safety performance indicators. In addition to these indicators, the authority continuously applies the engineering, safety evaluation, since the safety performance of the facility can be determined only as a result of a comprehensive evaluation. The comparison with the results and performance indicators of previous years can be relevant for the evaluation of the safety performance in the actual year.

I.1. Safety Performance Indicator System (SPIS)

The safety performance indicator system, at the request of the HAEA, was developed by the VEIKI Electric Power Research Institute Ltd based on the guidance of the International Atomic Energy Agency contained in IAEA TECDOC-1141. In the case of the most important nuclear facility, namely the PAE, the system was introduced in 2001.
Based on the lessons learned from its application at the nuclear power plant, SPIS was developed for the other facilities being under the regulatory oversight of the HAEA, namely for the SFISF, the BUTE INT TR, and the BRR, which systems are in use as of 2005. Consequently, the evaluation is supported, in the case of all facilities, by the results of the SPIS. In connection with the oversight of the radioactive waste repositories, the HAEA started its regulatory activity in the second half of 2014. The evaluation main areas, the indicators and attributes of the safety performance indicator system supporting the evaluation of radioactive waste repositories had been developed, the data collection is in process. The evaluation criteria system will be established based on the experience gained.

The appropriate selection of indicators allows continued monitoring, assessing changes, and detecting degrading tendencies early. If deviations are detected early, then the authority may initiate appropriate actions to prevent the degradation of safety below the acceptable level.

The evaluation criteria of safe operation are determined by the authority by taking account of the level of safety performance reached in recent years and the national and international experience, in order to facilitate the licensees in early detection of safety problems.

The following sources provide data to the safety performance indicator system:

- Regular reports (quarterly report, semi-annual report, annual report, campaign preliminary report, campaign report, campaign closure report, main overhaul report, maintenance report, repair report)
- Event reports on safety related events and their investigations
- Conclusions of regulatory inspections
- Information from regulatory licensing activity

The HAEA continuously oversees the operation of the nuclear facilities and the radioactive waste repositories. This oversight includes various types of regulatory licensing procedures, inspections, and review and evaluation of the regular and event reports of the operator.

The collection, calculation and management of data necessary for the operation of the SPIS is performed in line with a procedure, based on predetermined distribution of tasks and responsibilities. The tasks and responsibilities cover the collection of the data of

safety attributes, trend development, calculation of safety performance indicators, and the preparation of the summary evaluation and the sections describing the evaluation of events, inspections, licensing, organisational aspects and nuclear emergency response.

I.2. Structure of the SPIS

The SPIS consists of four levels; it has a hierarchic structure (see Figure I.1.-1). Three main evaluation areas are on the top of the system. Each area is divided to sub-areas of safety performance indicators. The safety performance indicators are built from safety attributes, which have measurable ad predefined evaluation criteria. The safety performance indicators and the sub-areas are evaluated based on the results of the safety attributes.

MAIN EVALUATION AREA	**Paks Nuclear Power Plant – 2. Operational safety**																										
EVALUATION AREA	2.1 Safety systems and equipment								2.2 Preparation								2.3 Risk										
INDICATORS	2.1.1 Actual challenges of safety systems				2.1.2 Availability				2.2.1 Operational readiness				2.2.2 Emergency preparedness				2.3.1 Risk in operation				2.3.2 Risk in analysis				2.3.3 Environmental risk		
ATTRIBUTES	2.1.1.1 AP-1 occurred on power				2.1.2.1 Inoperability revealed during tests				2.2.1.1 Number of personnel having authority licensing exam				2.2.2.1 Deficiencies in ERO exercises				2.3.1.1 Number of TS violations				2.3.2.1 Safety risk of events				2.3.3.1 Airborne and liquid release		
	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016
	2.1.1.2 Number of AP-1				2.1.2.2 Operability of Diesel generators				2.2.1.2 Number of failed authority licensing exams				2.2.2.2 Ration of participants in ERO training				2.3.1.2 Number of operations under the TS								2.3.3.2 Low and intermediate level solid radioactive waste		
	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016					2013	2014	2015	2016
	2.1.1.3 Number of AP-3				2.1.2.3 Operability of pumps																				2.3.3.3 High level solid radioactive waste		
	2013	2014	2015	2016	2013	2014	2015	2016																	2013	2014	2015	2016
	2.1.1.4 ECCS actuations				2.1.2.4 Availability of safety systems																				2.3.3.4 Liquid radioactive waste		
	2013	2014	2015	2016	2013	2014	2015	2016																	2013	2014	2015	2016

Figure I.1-1: Structure of the Safety Performance Indicator System

The HAEA groups the indicators under three major evaluation areas for each facility as follows:

PAKS NUCLEAR POWER PLANT
- smooth operation,
- operational safety,
- commitment to safety;

SFISF
- smooth operation,
- operation with low risk,
- operation with a positive safety attitude;

BUTE INT TR
- smooth operation,
- operation with low risk,
- operation with a positive safety attitude;

BRR
- smooth operation,
- operation with low risk,
- operation with a positive safety attitude;

RWTDF
- smooth operation,
- operation with low risk,
- operation with a positive safety attitude;

NRWR
- smooth operation,
- operation with low risk,
- operation with a positive safety attitude.

Due to the differences between the facilities, the evaluation of the safety performance is based on different attributes. The number of attributes and indicators are shown in the below table:

	Paks NPP	**SFISF**	**BUTE INT TR**	**BRR**	**RWTDF**	**NRWR**
Number of main evaluation areas	3	3	3	3	3	3
Number of evaluation areas	9	-	-	-	-	-
Number of indicators	22	10	12	12	10	10
Number of attributes	58	19	24	30	19	19

Table I.1-1: Number of attributes and indicators for each facility

The safety attributes are evaluated by the authority based on individually specified criteria and they are colour-coded as follows:

„green": If a safety attribute is in the green field, then it is within the limit values defined as adequate by the authority. The values in the green field are judged as acceptable by the authority, additional measures or strengthened attention are not considered as necessary. In the case of a degrading trend or if a value gets closer to the yellow field, the licensee, recognising the issue, may implement preventive measures.

„yellow": The boundaries of the warning, yellow field warns of deviation from the adequate value, however the performance is within the range accepted by the authority. The attributes within the yellow field require strengthened attention; the licensee shall prepare an action plan for the elimination of the inadequate qualification. The authority enforces the implementation of the action plan in writing; the realization of the plan is verified during the review of the regular reports as well as during targeted inspections.

„red": The safety attribute is non-acceptable, the lowest boundary of the red field is either the value approved by the authority or (if it is a lack of a specified value) an individually specified criterion. The licensee shall prepare an action plan, the implementation of which, if appropriate, with additional tasks considered to be important is ordered by the authority. The realization of the tasks listed in the action plan shall be reported by the licensee in regular reports; additionally, the authority verifies the progress of the implementation of these tasks during targeted inspections.

„white": The safety attribute is unknown. It may have various reasons: one of them is when such a modification occurred in the organization or in the informatics systems of the licensee, which temporarily hinders or makes impossible the data collection regarding the attribute. The reporting system shall be reviewed in this case to determine whether the information can be obtained from other sources or it shall be agreed with the licensee how it can ensure the data provision again.

The evaluation shall be made according to other aspects in addition to the qualification colours, in order to take into account, the information obtained by the authority from other sources besides the numerically assessable safety attributes.

The authority plays a special role during the operation of the SPIS, since it cannot influence the values of the attributes, it does not have direct role in their evolution.

The information gained from the safety attributes facilitates the authority in the identification of problematic areas and in determination of the necessary regulatory steps. The results of the SPIS show the areas, where the capabilities shall be enhanced, and the measures, which are required for the improvement of the performance in the future (in the area of human resources, system and equipment, or procedures).

The authority informs the management of the nuclear facility or radioactive waste repository about the results of the evaluation, and draws the attention to those phenomena, which requires further investigation and measures; or if needed, the authority conducts investigation and initiates actions.

The safety performance indicators are composed of associated, but not substitutable safety attributes; thus, the colour qualification of a safety indicators is made on the basis of the weakest colour qualification of its composing safety attributes.

The change of the safety performance level is shown in a circle diagram (see Figure I.1-2). The diagram shows the numeric values of safety attributes in a relative scale, where the values of the attributes are represented in increasing order, in percentage of the criteria specified in the different fields. The three sectors represent the three safety areas, the three levels of evaluation range are represented by the green circle, and the yellow and red rings. The area contained by the values represents the general summary of the safety performance for a given period of time. It provides an overview of the problematic sub-areas identified by the SPIS and the timely evolution of safety performance. The change of each area in time can be well followed based on the envelope of the values of the safety attributes.

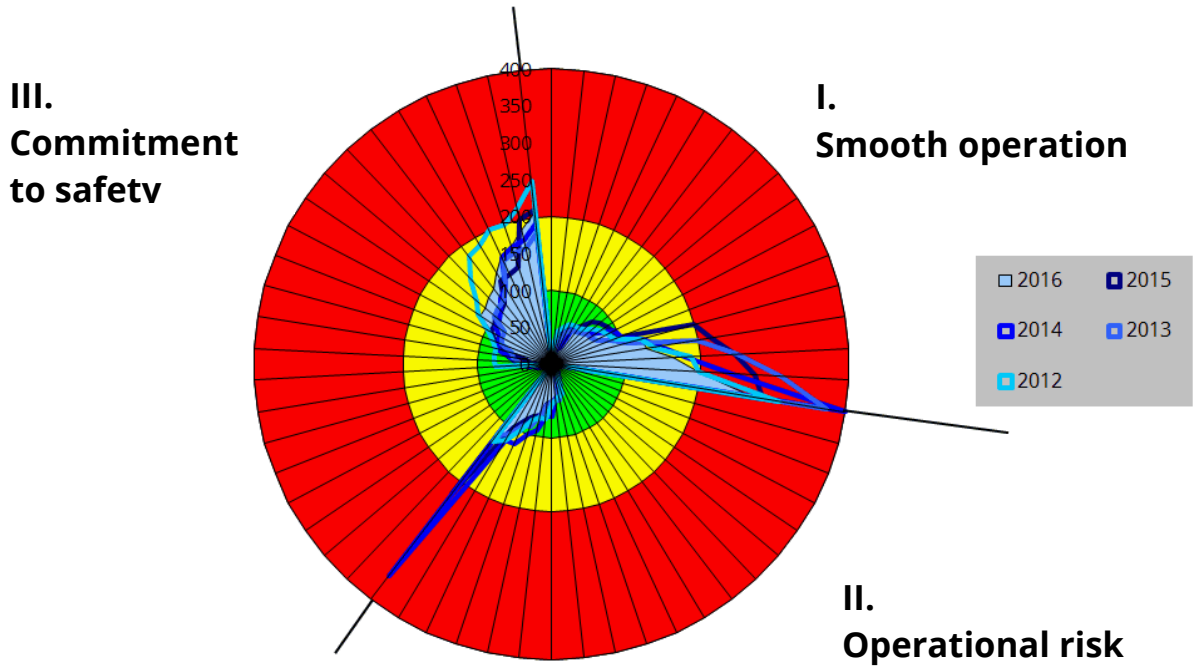

Figure I.2-1: SPI circle diagram

I.3. Safety evaluation of events

The HAEA introduced a complementary method for the safety evaluation of events. The evaluation activity is based on the so called IRS codes developed and implemented by the IAEA, which are incorporated into the authority investigation and record keeping system. The evaluation methods categorise the events based on their safety impact in a way that it provides points to the safety importance of various deviations. The sum of the points given to each attribute, as determined during the evaluation, characterises the events. The assessment provides a relative scale, which represents the safety relevance of the events in comparison with each other. The point value associated with a specific event cannot be used as an absolute indicator; however, the event having greater point shows more safety related deviation. The evaluation system pays emphasised attention to events associated with various types of human errors. The results of the evaluation facilitate the judgement on the safety relevance of the events and the elaboration of the regulatory inspection strategy aiming at the elimination of the causes of the events.

The method is built on data that can be gained from investigations. The aspects determining the evaluation are as follows:

- initiating event,
- protection actuation,
- operation under the effect of the OLC or violation of the OLC,
- activity of the personnel,
- value of core melt probability during the event,
- cause of the event,
- other contributing factors of the occurrence of the event,
- safety class of the affected systems and components,
- radiation exposure to the personnel,
- extent of radioactive release/contamination.

After concluding the investigation, the listed event attributes are valued according to the relevant procedure, and the sum of the points characterises the event.

The safety evaluation of events aims at better indicating the order of importance among the reportable events (typically INES-0, so below scale events having no safety significance).

II. Annex: Hungarian nuclear facilities and radioactive waste repositories

II.1. Paks Nuclear Power Plant

Paks Nuclear Power Plant (Source: www.atomeromu.hu)

Unit	Power	Start of operation	Type	Site	Internet site
Unit 1 PAE1	508.5 MW	1983	VVER-440/213	Paks	www.atomeromu.hu
Unit 2 PAE2	504.2 MW	1984	VVER-440/213		
Unit 3 PAE3	500 MW	1986	VVER-440/213		
Unit 4 PAE4	500 MW	1987	VVER-440/213		

II.2. Spent Fuel Interim Storage Facility

Spent Fuel Interim Storage Facility (Source: http://www.rhk.hu/letesitmenyeink/kkat/)

Type	Year of construction	Site	Internet site
Modular, chamber, dry store	1997-	Paks	http://www.rhk.hu/letesitmenyeink/kkat/

II.3. BUTE INT Training Reactor

Training Reactor (Source: www.reak.bme.hu)

Type	Power	Start of operation	Site	Internet site
Pool type	100 kW_{th}	1971	Budapest District XI. Műegyetem quay	www.reak.bme.hu

II.4. Budapest Research Reactor

Budapest Research Reactor (Source: www.bnc.hu)

Type	Power	Start of operation	Site	Internet site
Tank type	10 MW_{th}	1959	Budapest, District XII	http://www.aeki.kfki.hu/

II.5. National Radioactive Waste Repository

NRWR (Source: www.nrht.hu)

Type	Capacity	Commissioned in	Site	Internet site
Underground disposal	21500 m^3	2012	7164 Bátaapáti Mórágy Valley 4.	http://www.rhk.hu/letesitmenyeink/nrht/

II.6. Radioactive Waste Treatment and Disposal Facility

RWTDF (Source: www.rhft.hu)

Type	Capacity	Commissioned in	Site	Internet site
Shallow land disposal	5040 m^3	1976	2166 Püspökszilágy 043/20 Land No.	http://www.rhk.hu/letesitmenyeink/rhft/

III. List of abbreviations

AP	Accident Protection
BRR	Budapest Research Reactor
BUTE INT TR	Budapest University of Technology and Economics Institute of Nuclear Techniques Training Reactor
ECCS	Emergency Core Cooling System
ERO	Emergency Response Organization
FSAR	Final Safety Analysis Report
HAEA	Hungarian Atomic Energy Authority
IAEA	International Atomic Energy Agency
INES	International Nuclear Event Scale
IRS	International Reporting System
NUBIKI	Nuclear Safety Research Institute
NRWR	National Radioactive Waste Repository
NSC	Nuclear Safety Code
OLC	Operational Limits and Conditions
PURAM	Public Limited Company for Radioactive Waste Management
RPMS	Radiation Protection Monitoring System
RWTDF	Radioactive Waste Treatment and Disposal Facility
SAM	Severe Accident Management
SFISF	Spent Fuel Interim Storage Facility
SPIS	Safety Performance Indicator System
TS	Technical Specifications
VVER	Pressurized Water Reactor
WPRPR	Workplace Radiation Protection Rules