REGULATORY EVALUATION OF THE HUNGARIAN NUCLEAR FACILITIES AND RADIOACTIVE WASTE REPOSITORIES IN 2019

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, 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 2019 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 essentially 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

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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 conduction of activities associated with atomic energy entailing such risks.

Evaluation methodology
The safety evaluation of operation of nuclear facilities and radioactive waste repositories is performed on the one hand by complex numerically quantified characteristics, so-called safety performance indicators. In addition to these indicators, the Authority also applies engineering analysis based safety evaluations, 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 also 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.

During the evaluation of the safety performance of nuclear facilities and radioactive waste repositories being under its regulatory oversight the HAEA takes into consideration the degree of their potential hazardousness.

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 2019, the facility **operated essentially 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 additional 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 again took up a value within the order of 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 2019.
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)

In the Safety Performance Indicator System (hereinafter referred to as the SPIS) of Paks Nuclear Power Plant, it can be summarised based on the qualification of the

safety performance indicators that the areas of "operational safety" and "commitment to safety" slightly degraded, while the area of "smooth operation" showed an improving tendency.

In 2019, **the area of smooth operation** was characterised by 4 green, 2 yellow and 0 red indicators. In comparison with the preceding year, the number of red indicators decreased by two, the number of yellow indicators did not change, while the number of green indicators increased by two. Among the 17 safety attributes providing basis for the indicators 14 were green, 3 were yellow and 0 were red. Among the attributes, the qualification of 4 improved, 13 did not change and none degraded in comparison with the preceding year.

- The *"Maintenance planning"* indicator was red since 2017, but it improved to yellow in 2019. The contributing *"Ratio of performed and planned work orders"* attribute remained yellow, while the "*Ratio of planned and real length of main overhauls"* attribute improved to yellow.
- The qualification of *"Use of load cycles"* attribute improved to yellow from red, which caused that the *"Material condition"* indicator also became yellow.
- The *"Reportable event"* indicator was red between 2015 and 2017, it was yellow in 2018, due to the improvement of the *"Authority ordered event investigations"* attribute. It further improved to green in 2019.
- The *"Unplanned shutdowns and power reductions"* indicator improved to green in 2019 due to improvement of the *"Power reduction due to internal causes"* attribute to green.
- The *"State of the barriers"* indicator is of green qualification.
- The *"Repairs"* indicator kept its green qualification.

The **area of operational safety** was characterized by 6 green indicators, and 1 red indicator in 2019. As compared to the previous year one indicator changed to red from green, one indicator improved from yellow to green, while all the rest remained green. Among the 19 safety attributes composing the indicators 18 are qualified as green. 1 attribute degraded, 1 attribute improved, while 17 remained unchanged in comparison with the preceding year.

- The *"Risk in analysis"* indicator was continuously green from 2011, but it degraded to red in 2019.
- The "*Environmental risk"* indicator was green since 2015, it became yellow in 2018 due to degradation of the *"Amount of generated liquid radioactive waste"* attribute, but it improved back to green again in 2019.
- The *"Actual operation 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"*. It improved to yellow in 2016, then in 2017 it further improved and obtained green qualification again, which was sustained in 2019.

- The *"Emergency preparedness"* indicator has been green since 2006.
- The *"Risk during operation"* indicator has been qualified as green already for five years.

The area of commitment to safety, in 2019, was characterised by 5 green, 2 yellow and 2 red indicators. The number of red indicators increased by one, the yellow ones decreased by one, while the number of green indicators did not change in comparison with the preceding year. There were 15 green, 4 yellow and 3 red attributes among those 22 safety attributes that provided basis for the indicators. Among the attributes, 4 improved, 3 degraded and 15 remained unchanged in comparison with the preceding year.

- The *"Deviation from planned state"* indicator was red in the last two years. The *"Number of modifications of the Operational Limits and Conditions"* attribute improved to green and the *"Temporary modifications"* to yellow, but in 2019 the *"Temporary deviations from the OLC"* and the *"Operational instructions"* attributes obtained red qualification, so the indicator also remained red.
- 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 still kept this qualification in 2019.
- The *"Deviations in the reporting system"* indicator was six times red and for four years yellow of the 10 years between 2008 and 2017. The *"Delay in the submission of event investigation reports"* attribute degraded to yellow, while the *"Delay in reporting of immediate reportable events"* attribute degraded to red, since the reporting requirement was not always fulfilled within two hours, so the indicator degraded to red in 2019.
- The *"Radiation protection programme effectiveness"* indicator improved to green as a consequence of the improved qualification of the *"Significantly radiation hazardous work programmes"* attribute to green.
- The *"Industrial safety programme effectiveness"* indicator has been qualified as green since 2018.
- The *"Human factor"* indicator has been green for four years.
- The *"Self-assessment"* indicator has been green as of 2007.
- The *"Corrective measures"* indicator remained yellow. The *"Corrective measures of investigations"* attribute improved to green in 2019, but the *"Corrective actions of quality assurance related audits"* attribute is still yellow.
- The *"Operational experience feedback"* indicator improved to green from yellow in 2017 due to change of the "Recurring events" attribute from yellow to green, which state was sustained in 2019.

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 2019, there was no such an attribute.

Events

In 2019, 10 reportable events occurred, including four 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 2019, an event with AP1 (Accident Protection) actuation occurred once, in addition to three events with AP3 actuation. Human or documentation error was identified once by the investigations. The authority determined two events as reoccurring events. Real ECCS (Emergency Core Cooling System) actuation did not occur in 2019, 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 2019 was the Diesel generator. Greater attention and the investigation of causes are justified in this area.

The HAEA and its technical support organisation, the Nuclear Safety Research Institute (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 were still under the regulatory and legal 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. B41901 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 decreased, while the number of events entailing AP1 actuation, and of events entailing the inoperability of two safety systems did not change in comparison with 2018. The number of events associated with the Diesel generator, reoccurring events, and of events entailing AP3 actuation did not change. The number of events entailing forced power reductions exceeding 50% decreased, and the number of events associated with foreign material increased; however, these values were not extraordinary in the view of the last 5-10 years. Every event was classified as INES 0 (International Nuclear Event Scale), without safety significance. Events entailing the violation of the OLC or ECCS operation did not occur since 2014. There was no radiation safety related event in 2019. Both the ratio and the number of events induced by human errors significantly 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 282 regulatory decisions in 2019, including 144 conclusive decisions and 138 procedural decisions.
Among the decisions, 209 decisions were related to Units 1-4 of Paks Nuclear Power Plant. The building authority tasks of the nuclear facilities are performed by the HAEA. With the involvement of co-authorities, 69 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. With regard to practices of profession the HAEA made 163 decisions, 42 out of which were for the application of Paks Nuclear Power Plant.

The number of conclusive decisions related to Paks Nuclear Power Plant is 67% more than issued in the preceding year. 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. The Authority issued a significant number of modification licenses in relation to licensing of the Periodic Safety Review (hereinafter referred to as: PSR) tasks.

Inspection

In 2019, 437 inspections were recorded at Paks Nuclear Power Plant, including 342 on-site inspections, 52 delivery-acceptance, 21 clarifications of cases and 22 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,
- Inspections related to the performance of PSR tasks,
- 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 the adequacy of the preliminary safety evaluation of the planned modifications 189 times (inspection records are not made about these inspections, they are recorded in an individual database). Many inspection records were made in relation to the Targeted Safety Review (hereinafter referred to as: TSR) and the PSR, and 4 inspections were conducted in connection with event investigations.

The HAEA performed a comprehensive inspection at the Paks Nuclear Power Plant in the fields of implementation of organizational changes, provision of human resources and long term planning. 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.
Paks Nuclear Power Plant conducted 123 contractor qualification procedures in 2019, 77 out of which took place via an on-site audit and 46 via documentation review. The HAEA representatives participated in 55 on-site audits as observers.

Nuclear Emergency Response
In accordance with the provisions of the Nuclear Safety Code (hereinafter referred to as NSC), Paks Nuclear Power Plant shall conduct a full scope nuclear emergency response exercise once every year 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 2019 by the Paks Nuclear Power Plant. A primary circuit break (large break LOCA) was the initiating event of the exercise, followed by the unavailability of all three ECCS trains, which caused a loss of core cooling and finally core damage. The assumed accident scenario took place on Unit 1. The ERO of Paks Nuclear Power Plant performed its tasks at an appropriate level and adequately informed the off-site organisations about the occurrences.

As an outcome of the TSR 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 exercises in 2019, the ERO demonstrated that it could respond to multi-unit emergencies.

Besides, Paks Nuclear Power Plant conducted three unannounced alerting drill for the duty officers of the ERO to check the readiness. Other partial and management exercises were also conducted as well as an exercise involving conventional dangerous material.

Paks Nuclear Power Plant together with WANO (World Association of Nuclear Operators) MC Regional Crisis Centre organized a joint information exchange exercise in the area of information and cooperation and participated in the “ConvEx-2b” international nuclear emergency response exercise on 26-28 March 2019 organized by the IAEA, during which the aim was to practice the implementation of the convention on assistance in nuclear emergencies.

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 2019, the HAEA concluded that the **facility operated essentially 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 favorably low, much lower than the regulatory limit values. The facility was operated in compliance with the OLC.

It can be stated that the nuclear safety level of the nuclear facility in 2019, in comparison with 2018, decreased in the areas of „Smooth operation" and „Operation with a positive safety attitude". The first one due to the red qualification in 2017 and yellow qualification in 2019 of the *"Adequacy of planned storage time"* attribute, while the latter one due to the red qualification in 2019 of the *"Violations of requirements"* attribute will require increased regulatory attention.

Figure 2.2-1: SFISF bird view (source: https://rhk.hu/gallery/a-kiegett-kazettak-atmeneti-taroloja-kkat/files)

In 2019, the SPIS of the SFISF was composed of 8 green, 1 yellow and 1 red indicators. Among the attributes, 17 were green, 1 yellow and 1 red.

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. This attribute degraded to yellow in 2019, so the corresponding indicator became yellow as well. The yellow qualification of the *"Installed radiation protection monitoring system"* attribute appeared once in 2015, and 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 degradation of the *"Violation of requirements"* attribute caused the *"Human factor"* indicator to change to red. In 2019 violations of requirements were confirmed 4 times, from which 3 were violation of legal requirements, while 1 was violation of a regulatory requirement. The HAEA confirmed these violations altogether during 3 enforcement processes, from which 2 were terminated in 2019 (with the conclusive decisions RHKK-HA0042 and RHKK-HA0044), while the third one in 2020 (but before completion of this evaluation, with the conclusive decision NBE-HA0054). All three procedures were closed by imposition of fine. Out of the legal violations one was associated with communication within the operating organization and with the operator due to inaccurate and delayed transfer of information necessary or prohibition of work performance, one violation was associated with the lack of internal regulation of prohibition of work performance, while in case of the third one, the license did not timely perform the validation of the electronic personal dose-rate meters. The violation of regulatory requirements was the submission of a modification evaluation report after the deadline specified by the authority. These violations point to the need for increasing the level of safety culture.
All the other indicators and attributes of the area fall 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 2019, in the SFISF 1 reportable event occurred (No. 2111) and 1 event was requested to be reported as an event by the authority (No. 2129).

- Event No. 2111: in February 2019, prohibition of work performance was ordered in the SFISF because of violation of various radiation protection rules. This measures and subsequent internal communication of the licensee and the communication with the authority pointed to deficiencies in safety culture. The event investigation did not fully reveal the background of the event and so the HAEA requested more supplementations. The decided corrective measures contained the revision of the concerned procedures and improvement of information exchange between the organizational units of the licensee. A part of the measures was already realized, but some of them were postponed to 2020.

- Event No. 2129: on 13 August 2019 the operator performing water release, during release of water from the shower water tanks of the SFISF personnel, experienced that the tank did not empty and the low water level protection of the discharge pump stopped the pump at start-up. The failure was caused by a faulty signal because of fouling of the shower water tank level gauge. After cleaning of the level gauge, the failure was eliminated. The failure did not necessitate any further action beyond the already required, annual maintenance. With regard to a similar event in the preceding year, the HAEA requested that the licensee examined if a regular check applied for level gauges operated with similar technology is necessary to be introduced.

Licensing

The HAEA made 5 conclusive decisions and 10 procedural decisions related to the facility in 2019. The subjects of the decisions were related to: (1) modification license for the modification of the SFISI Emergency Preparedness and Response Plan (hereinafter referred to as the EPRP), (2) extension of validity of the modification license related to the current collector skate of the SFISF container transport carriage, (3) approval of the waste exemption methodology, (4 and 5) two decisions concluding enforcement procedures. The procedural decisions were related to calling for supplements, launching procedures ex officio, and in one case termination of a procedure.

Inspection

In 2019, the HAEA conducted 10 nuclear safety inspections at the SFISF, out of them 1 was a comprehensive inspection. The HAEA paid special attention to the identified deviations, furthermore, according to the annual inspection plan conducted a comprehensive inspection, performed the inspection of radiation protection, civil engineering conditions and an inspection of certain part of the preparation and conduct of the fuel assembly storage process. Several inspections determined in the 2019 annual inspection plan were cancelled or rescheduled to next year: inspection of construction of Chambers 25-28 due to delay of commencement of construction to 2020, inspection of commissioning of modification of current collector skate of the container transport carriage due to delay of commissioning to 2020, while inspection of SPIS was cancelled due to lack of resources.

The occasional inspections were conducted according to the related inspection plans; the licensee and the participating contractors cooperated in every case with the HAEA inspectors. Immediate regulatory interventions did not become necessary in any case.

Enforcement

The HAEA identified non-compliances in more cases during the occasional inspections. Two enforcement procedures were launched and closed during the subject year:

(1) The HAEA made its conclusive decision No. RHKK-HA0042 corresponding to the prohibition of work in the SFISF between February and April 2019 and the preceding communication issues between the Public Utility for Radioactive Waste Management (hereinafter referred to as the PURAM) and the operator of the SFISF (Paks Nuclear Power

Plant) and within PURAM, and for management of the legal deviations identified in the internal regulations of the PURAM. The decision did not limit activities. It obliged the PURAM to pay the fine of 250.000 HUF and to comply with the violated legal requirements and demonstrate the compliance.

(2) The HAEA made its conclusive decision No. RHKK-HA0044 because of using electronic personal dose rate meters of expired validity in the SFISF, to manage the deviation from the internal regulations of the PURAM (Workplace Radiation Protection Rules, hereinafter referred to as WRPR) and from the legal requirements. The decision did not limit activities. The HAEA obliged the PURAM in this decision to pay 100,000 HUF fine.

Nuclear Emergency Response

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

The licensee of the facility performing the interim storage of the spent fuel of a nuclear facility shall conduct a nuclear emergency exercise with the involvement of the entire ERO at least once in every two years, in which it involves the organizations responsible for off-site emergency preparedness. Such an exercise took place in May of 2019. During the exercise the Paks Nuclear Power Plant ERO appropriately performed the tasks.

Organisational Factor

The HAEA inspected the training system based on its annual inspection plan. A representative of the HAEA inspects the authority licensing examinations. It was concluded during the inspections that the organisation, conduct and documentation of the examinations were performed according to the effective provisions. The review of the training material was performed in line with the internal regulations. In summary, it can be stated that the HAEA did not identify such an issue 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 2019, the HAEA judged that the **facility operated essentially 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, while the areas of "smooth operation" and "operation with a positive safety attitude" moved from the range of good qualification to the range that requires authority action.

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 2019, the SPIS of the BUTE INT TR consisted of **9 green and 3 yellow indicators**. Among the safety attributes, 21 were green and 3 were yellow. In comparison with 2018, the degradation of three attributes caused the qualification of three indicators; namely, the *"Radiation protection monitoring system"* attribute of the *"Safety systems, equipment"* indicator, the *"Violation of rules"* attribute of the *"Human factor"* indicator, and the

"Individual dose" attribute of the *"Radiation protection programme effectiveness"* indicator changed from green to yellow.

Two indicators of the **area of smooth operation**, namely the *"Operating performance"*, 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. In 2019, the *"Safety systems, equipment"* indicator degraded to yellow due to the yellow qualification of the *"Radiation protection monitoring system"* attribute.

In the **area of operation with low risk**, the *"Safety systems, equipment"* indicator has kept its green qualification, currently for five years since 2015, because the *"Number of safety protection system failures"* attribute stayed green again based on the data of 2019. 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 improved to green in 2018 due to the improvement of the *"Number of violations of the requirements"* attribute from red (in 2017) to green. However, this attribute degraded to yellow in 2019, and caused the yellow qualification of this indicator. The *"Radiation protection programme effectiveness"* indicator became yellow, due to the *"Individual dose"* attribute. The other indicators of the area, the *"Striving for improvement, self-assessment"*, *"Operating experience feedback"*, and *"Industrial safety programme effectiveness"* indicators have been continuously green for years.

Events

Two reportable events occurred at the BUTE INT TR in 2019.

- Log No. 2092 event: on February 11, 2019, during the preparation for reactor start-up, the control room personnel observed the failure of an electronic unit. The installed safety functions could prevent the failure to cause any operating incident, even if the reactor would have been started (in violation of the rule). After assembling the spare unit, it was revealed that neither the spare unit worked properly. The electronics was repaired by the manufacturer based on contract. The failures did not occur during operation, but during the pre-starting inspection of the reactor, in its subcritical state, thus there was no any safety consequence induced. The licensee amended its maintenance instruction to require the testing of spare units.
- Log No. 2139 event: on September 18, 2019, after the shutdown of the reactor, the irradiation capsule removed from the active core after irradiation fell from its holder to an invisible position within the reactor tank. The first try to identify the location of the capsule was unsuccessful, because the survey camera did not provide proper image in the vicinity of the core, due to the high dose rate. On the

next day, the decrease of the dose rate next to the core allowed the identification of the location of the capsule, and then its successful removal with another clamp.

Evaluation of the lessons learned from the events:
The event 2092 is caused by an individual failure; the failure of the spare unit was induced by a deficiency in regular testing. These issues were managed by corrective actions by the licensee.
The event 2139 was caused by ageing induced wear of the clamp. It did not required any additional direct measure; however, special attention has to be paid to ageing management in the BUTE INT TR.

Licensing
The HAEA made 12 authority decisions regarding the BUTE INT TR in 2019. The authority issued 2 conclusive decisions and 6 procedural decisions in relation to the license application to modify the EPRP. A conclusive decision and a procedural decision connected to the modification of the deadlines for 13 tasks determined in the conclusive decision closing the Periodic Safety Review, issued in 2017.

Inspection
In 2019, the HAEA performed 6 nuclear safety inspections at the BUTE INT TR, in line with its annual plan. The HAEA inspected the implementation of the actions made necessary by the requirements of the Periodic Safety Review, the condition of the building, and the proper application of radiation protection rules, the emergency response exercise, the provision of resources and the task management system of the TR. Furthermore, the HAEA inspectors performed an inspection in connection with an event, and inspected the authority examinations.

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.

Enforcement
The HAEA initiated an enforcement proceeding for the enforcement of the compliance with the provisions established in the WPRPR of the BUTE INT TR. In the frame of the proceeding, the HAEA obliged the licensee to eliminate the violation of the legal provision that was revealed during the inspection. As a consequence of the violation of the legal provision, the HAEA issued a warning to the licensee.

Nuclear Emergency Response
The BUTE NTI TR shall conduct, at least biannually, a full scope nuclear emergency response exercise with the participation of the entire Emergency Response Organisation, with the involvement of off-site emergency response organisations. The facility conducted the exercise on September 12, 2019. The HAEA inspected the exercise on the site; the exercise was successful. The exercise was evaluated both by the facility and the authority,

the decided corrective measures will contribute to the more effective operation of the ERO.

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 departments of the licensee could also suggest 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.

2.4 Budapest Research Reactor

Based on the evaluation of the safety performance of the BRR in 2019, the HAEA confirmed that **the facility operated** essentially **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 due to degradations indicated in the areas *of "smooth operation"* and *"operation with low risk"* enhanced authority attention is justified.
In 2019, the value of each indicator and attribute (except one) was green in the area of *"smooth operation"*. 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 degraded compared to the level of the preceding year with 1 degrading indicator.
The *"operation with low risk"* area obtained good qualification, with the exemption of one indicator that degraded to yellow. The area degraded compared to the level of the preceding year with 1 degrading indicator.
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, 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 1 improving and 1 degrading indicators.

Figure 2.4-1: Budapest Research Reactor (source: http://www.innoportal.hu/wp-content/uploads/2016/08/budapesti-kutat%C3%B3reaktor.jpg)

In 2019, the SPIS of the BRR consisted of 1 red, 3 yellow and 9 green indicators. Among the safety attributes, there were 1 red, 3 yellow and 26 green. Comparing to 2018, the qualification of 1 attribute improved from yellow to green, 3 attributes degraded from green to yellow, while 1 attributes degraded from green to red.

In the main evaluation area of *"smooth operation"*, the qualification of the *"Unplanned shutdowns and power changes due to internal causes"* attribute moved to the warning range, thus the *"Operating characteristics"* indicator became also yellow.

The *"Risk"* indicator in the area of operation with low risk *became yellow, due to the degradation of the "Number of OLC violations" to yellow. Other indicators*, namely the *"Releases" and* the "S*afety systems and equipment"* have been obtaining green qualification for years.

In the area of operation with a positive safety attitude, special attention should be paid to the *"Violations of requirements"* attribute within the *"Human factor"* indicator. The attribute got red qualification in 2016, yellow in 2017, then green in 2018, but it moved to the non-acceptable range again in 2019. In the frame of its comprehensive inspection in 2019, the authority evaluated the area in detail, and requested an action plan to eliminate the identified deviations.
The *"Striving for improvement, self-assessment"* indicator degraded to yellow in 2018 due to the degradation of the "*Independent internal audits*" to yellow because of deficient documentation of audits. The attribute remained yellow in 2019.
The *"Radiation protection programme effectiveness"* indicator improved to green due to the improvement of *"Radiation protection related event reports"* attribute to green.
The *"Operating experience feedback"* and the *"Industrial safety programme effectiveness"* indicators have been maintaining the green value for years.

Events
In 2019, 3 reportable events occurred at the BRR.

- Log No. 2098 event: On March 4, 2019, the automatic safety system stopped the reactor during scheduled start-up. The safety actuation was induced by an operatory failure, as the operator on duty, not in compliance with the operating regulation, did not pull up the moving chambers of the logarithmic measuring chain prior to taking the reactor to nominal power. The chambers have to be pulled up in order to prevent their damage. The shut-down was properly performed by the automatics, the reactor was continuously cooled. As a corrective measure to prevent recurrence, the licensee put special emphasis, in the frame of its annual training programme, on procedures to be followed during the start-up and shut-down of the reactor. Furthermore, the log management of the start-up procedures by operators was improved.
- Log No. 2149 event: On November 22, 2019, in the morning, during the inspection of the out-of-service state of the reactor, the pressure gauge of the secondary circuit and the water level of the pool belonging to the secondary circuit showed

zero value. The immediate failure investigation revealed that the level sensor of the pool failed and thus hindered the operation of the pump filling the secondary circuit. During the entire event, the reactor was in subcritical and cooled state. As a corrective action, the replacement of the similar measuring gauges in every 15 year was decided; the periodicity is proportional with the risk and based on engineering evaluation. Furthermore, the ”emergency minimum” signal of the measuring circuit will provide an indication in the signalling system operating in the portal of Building X.

- Log No. 2155 event: on December 20, 2019, during nominal power operation of the reactor, ”Failure at Diesel No.1” signal appeared due to a leakage at the water pump of the Diesel machine. The pump could be repaired only in a special workshop. Based on the investigation, the professional and periodic maintenance of machine units had not been performed. In the future, the licensee orders the annual maintenance, inspection and repair of the machine units from a professional external company. Furthermore, the storage of spare parts was decided.

Evaluation of the lessons learned from the events:
The measures decided after the events are appropriate according to the judgment of the HAEA.

One more event occurred in 2019 than in the preceding year; however, the safety weight of neither of them was significant. Nevertheless, a recurring issue is the poor quality of the event investigation reports. The authority evaluation of events revealed that the BRR needs enhanced authority attention due to the known human and safety culture issues.

Licensing
The HAEA concluded 9 authority decisions in association with the facility in 2019. The HAEA issued 1 conclusive decision and 5 procedural decisions. The compliance proceeding with the amendment to Govt. decree 118/2011. entered into force on April 10, 2018 (the amending decree is the Govt. Decree 70/2018. (IV. 9.)) commenced by the application of the BRR in 2018. The HAEA terminated a modification in progress, because the client revoked its claim.

Inspections
In 2019, the HAEA conducted 9 nuclear safety inspections at the Budapest Research Reactor. In accordance with the annual inspection plan, the HAEA inspected the general radiation protection at the BRR, the radiation protection data management and provision, the maintenance actions, the activities associated with condition maintenance of civil structures, and along with 8 part-inspections the HAEA performed the comprehensive inspection of the BRR. After the transfer of the management rights over the CER from the HAS to the ELRN, the authority verified the licensee’s commitment to sustain nuclear safety. The HAEA inspected the conduct of the licensee’s institutional examination and its emergency response table-top exercises, and inspected the fuel element purchase procedure from nuclear safety point of view.

The comprehensive inspection of the licensee was performed in December, 2019. The HAEA's evaluation stated that the most significant deficiency regarding the facility appeared due to a reason that is out of the competence of the licensee: there is no strategic decision on the future of the research reactor. Therefore, the BRR has to prepare in parallel for each of the three determined possible life cycle phases (i.e. lifetime extension, partial or total decommissioning), in order to sustain the level of nuclear safety as required. According to the HAEA's evaluation the resource issues of the BRR mean serious risk. Furthermore, the inspections revealed deviations in the management system and the procedures of the BRR. Regarding the general condition of the facility, it can be stated that the facility is in good shape comparing to its age; however, the preservation and maintenance will require measures in the near future. It can be also stated that the on-site stage of the comprehensive inspection had not revealed any such nuclear safety issue that would have demanded immediate action from the authority. Based on the detailed evaluation report of the HAEA, the licensee developed an action plan by May 31, 2020, which was assessed by the authority and identified the corrective measures that are required for the management of the revealed deviations.

In summary, it can be stated that such an issue which might jeopardise fundamental safety was not identified by the regulatory body during the inspections performed in 2019, thus immediate authority intervention was not justified.

Enforcement

The HAEA, with a procedural decision, initiated by itself an administrative proceeding to enforce the compliance with regulatory provisions that was closed by a conclusive decision. During the proceeding, the HAEA obliged the licensee to eliminate the law violation regarding an administrative error identified at radiation protection job positions. The HAEA issued warning to the licensee in connection with the violation.

Nuclear Emergency Response

The BRR shall conduct, at least biannually, a full scope nuclear emergency response exercise with the participation of the entire Emergency Response Organisation, with the involvement of off-site emergency response organisations. The HAEA was the only authority that observed the on-site inter-institutional table-top exercise held on November 27, 2019. The specific goal of the exercise was to assess the operation of the Protected Command Center. The exercises was successfully completed by the participating personnel. The exercise was evaluated both by the facility and the authority; the decided corrective measures will contribute to the more effective operation of the ERO.

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. 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

Based on the evaluation of the safety performance of the NRWR in Bátaapáti in 2019, the HAEA determined that **the facility essentially 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 2019, 2 reportable events (one caused by natural phenomenon and another radiation safety related event) occurred during the operation of the NRWR.

Due to the failure of the 22/6 kV transformer, the NRWR lost the external power supply and thus transferred to power supply from the Diesel generator. The voltage changer installed in the sealed measuring cell of the 22 kV main distributor failed. The supplier eliminated the failure, then the energy provider switched back the electric supply of the site.

Due to the failure of the IT system of the National Radiation Monitoring, Early Warning and Surveillance System (NRMEWS), measuring data were not received from certain off-site monitoring station from a given timepoint. Until the elimination of the failure, on-site verification measurements were performed, then the recovery of the data provision was reported to the competent authorities.

Licensing

In 2019, in connection with the NRWR, based on the submitted documents, the HAEA granted three licenses (for the works of the sewage water collector tank park at the basement level of the technology building, in relation to meeting the new requirements established in Govt. decree 155/2014. (VI.30.) and for the modification works of lightning protection improvement) and commenced the safety evaluation of another planned modification (planned modification activities on the DKS-160 HUBTEX trolley).

In addition, the WPRPR of the NRWR was approved.

Inspections

In 2019, the HAEA performed 12 on-site inspections at the NRWR documented in inspection records. Out of them 3 inspections were related to realised modifications, 5 to the operation of the repository, while 4 to the construction process. Immediate action, intervention affecting the operation was not necessary during the inspections.

Nuclear Emergency Response

According to the law, the licensee 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.

Such a pre-announced emergency response exercise was not due in 2019 at the NRWR. The NRWR conducted three exercises, including a full scope EPRP exercises, an alerting drill and a two-stage exercise consisting of the alert of the ERO and a table top exercise of the nuclear EPRP. Each exercise was qualified as “appropriate”.

Organizational Factors

In line with its annual inspection plan, the HAEA inspected the training system. The inspections concluded that the organization, conduct and documentation of the trainings were in compliance with the effective regulations, training materials were updated according to internal rules. In summary, it can be stated that the authority did not identify any essential issue jeopardizing safety, thus ordering of any immediate authority measure was not justified.

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 in 2019, the HAEA determined that **the facility operated essentially 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.

Events
Reportable event did not occur at the RWTDF in 2019.

Licensing
In 2019, in connection with the RWTDF, based on the submitted documents, four regulatory licensing proceedings were initiated under the effect of the Govt. decree 155/2014. (VI.30.): application to obtain the operating license of the RWTDF, application for release from regulatory control of the construction debris generated on the site of the RWTDF as radioactive waste, application for licensing of modifications needed for the installation of the fresh air supply system in the service building of the RWTDF, and the approval of the workplace radiation protection rules of the RWTDF. Due to the amendment to the Govt. decree 155/2014. the PURAM initiated, in the frame of a public administration proceeding, the exemption from certain legal provisions for a definite period of time.

Inspection
In 2019, the HAEA performed 9 on-site inspections at the RWTDF in Püspökszilágy documented in inspection records. Out of them 5 inspections were related to preparatory activities for the Safety Improvement Measures planned on the site, and 4 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 licensee 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. Such a pre-announced full scope exercise was due 2019 in the case of the RWTDF, but it was postponed by the RWTDF to 2020. In 2019, the RWTDF conducted an ERO alerting drill, a two-stage exercise consisting of the alerting of the ERO and a table top exercise of the nuclear emergency preparedness and response plan, and also an emergency response exercise connected to an ERO alerting drill. All the exercises were qualified as „appropriate”.

Organizational Factors
Every employee employed in a job position requiring authority license participated in the required trainings and successfully passed the exams.

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 license 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 general 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. paks2.hu/)

Events
No event occurred in 2019 at Paks II. Ltd.

Licensing
In 2019, the HAEA issued building license for a restaurant (with 100 seats) and a kitchen, which will be built on the construction site.

Inspection
The HAEA performed 12 targeted and 1 comprehensive inspections in 2019. During the inspections, immediate actions, intervention to the activities did not become necessary.

A geological-geotechnical engineering survey is ongoing at the site performed by the Russian principal contractor and the involved subcontractors to collect additional 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. During the 3 inspections conducted in connection with the survey, the HAEA inspectors confirmed that the drilling activity (with one deviation) has been performed according to the requirements, the pre-job briefing took place and the documents necessary for the activity are available. In one occasion, there was no up-to-date information available on the scene about the relocation of the drilling point, and this was recorded by the HAEA inspectors.

In 2019, the HAEA paid special attention to the assessment and inspection of the verification of the design documents by the Licensee. The HAEA performed 2 targeted inspections to check the handover, review and approval process of technical design documentations (design specification and technical designs) of the construction of the new nuclear power plant units.

During the comprehensive inspection, the HAEA assessed the design verification process of the technical design documents, paying attention to configuration and change management. Following the inspection performed with the involvement of electric, instrumentation and control, civil engineering, mechanical engineering, safeguards and nuclear security professional areas, the HAEA sent its experience in its summary evaluation. The implementation of the action plan developed on the basis of the summary evaluation was ordered by the HAEA in 2020 with its conclusive decision P2-HA0054.

The building of the UYA 1.1.1 and 1.1.2 office buildings and the UYA 1.1.3 restaurant (with 100 seats) and kitchen started in the construction area, which were inspected several times by the HAEA on the site or by remote inspection.

Paks II. Ltd performed 29 supplier qualification and supervisory audits in 2019, including 15 with site audit and 14 with documentation review. The representatives of the HAEA participated, as observers, in 9 site audits in the Russian Federation and 3 in Hungary.

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.

The HAEA received 12 status reports in 2019, 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 at 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 operation 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 increased 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 there 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 the data collection regarding the attribute impossible. 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.

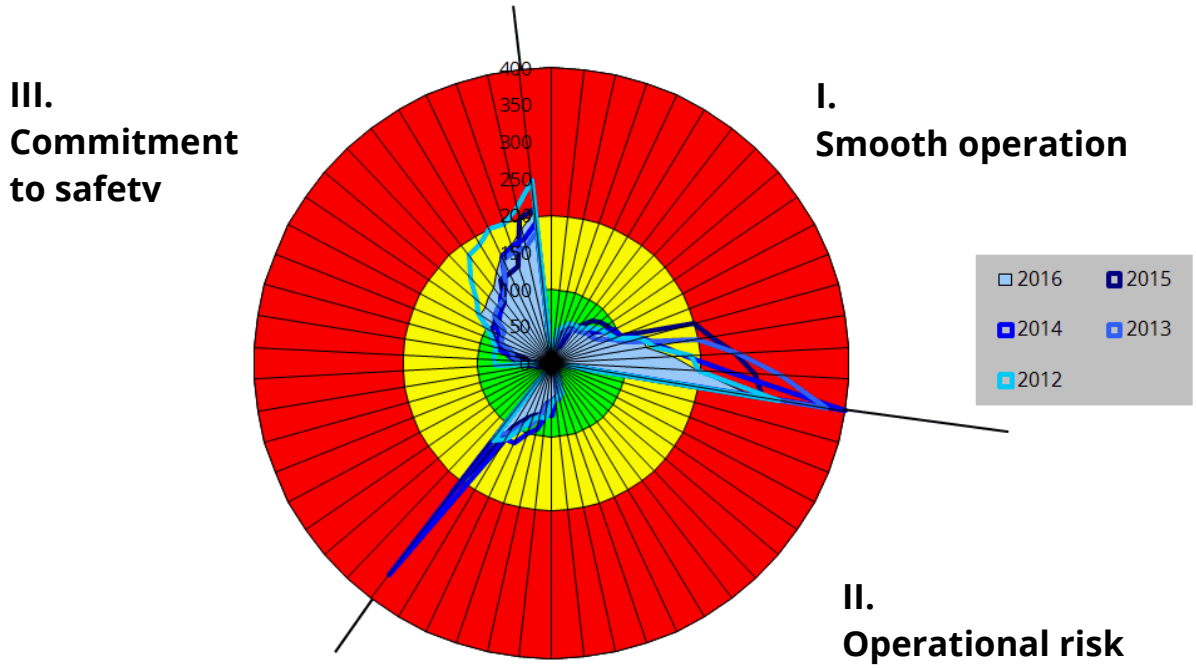

Figure I.2-1: SPI circle diagram

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 TS/OLC or violation of the TS/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	508.6 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: https://rhk.hu/gallery/a-kiegett-kazettak-atmeneti-taroloja-kkat/files)

Type	Year of commissioning	Site	Internet site
Modular, chamber, dry store	1997-	Paks	https://rhk.hu/timeline/a-kiegett-kazettak-atmeneti-taroloja-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.energia.mta.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
CER	Centre for Energy Research
ECCS	Emergency Core Cooling System
ELRN	Eötvös Lóránd Research Network
EPRP	Emergency Preparedness and Response Plan
ERO	Emergency Response Organization
HAEA	Hungarian Atomic Energy Authority
HAS	Hungarian Academy of Sciences
IAEA	International Atomic Energy Agency
INES	International Nuclear Event Scale
IRS	International Reporting System
ISM	In-service Maintenance
NRWR	National Radioactive Waste Repository
NSC	Nuclear Safety Code
OLC	Operational Limits and Conditions
PURAM	Public Limited Company for Radioactive Waste Management
RWTDF	Radioactive Waste Treatment and Disposal Facility
SFISF	Spent Fuel Interim Storage Facility
SPIS	Safety Performance Indicator System
TS	Technical Specifications
VVER	Pressurized Water Reactor
WANO	World Association of Nuclear Operators
WPRPR	Workplace Radiation Protection Rules