REGULATORY ASSESSMENT OF THE HUNGARIAN NUCLEAR FACILITIES AND RADIOACTIVE WASTE REPOSITORIES IN 2020

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. One of the main duties of the Hungarian Atomic Energy Authority (HAEA) is to guarantee nuclear safety, prevention of the occurrence of a nuclear accident, in the frame established by the legislation, 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, and the safety level of their activities.

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

The evaluation performed by the HAEA is based on the safety performance indicator system developed specifically for nuclear facilities and radioactive waste repositories, the outcomes of inspections, licensing experience, regular reports submitted by the facilities and event reports aiming at the investigation of more significant deviations and their elimination. The primary objective of the evaluation is to provide feedback to the licensees of nuclear facilities on the regulatory perception 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 of the year 2020 in general that the nuclear facilities under the regulatory oversight of the HAEA (i.e. Paks Nuclear Power Plant – Paks NPP, 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 cause health risk increment for the employees of the facilities nor the public.

In addition to the maintenance and 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 Periodic Safety Reviews (PSR) and the Targeted Safety Reassessment (TSR) 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 any events that are adversely affecting nuclear safety.

Andrea Beatrix Kádár
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 governed 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 perception on nuclear safety related results reached in the given year, in order to facilitate the maintenance and enhancement of the 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 nor the environment. Another important aspect is that the oversight shall not hinder, more than justified, the operation of facilities and equipment, or conduct 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 be significant for the evaluation of the safety performance of the actual year.

The evaluation of safety performance is performed 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 safety assessment 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. Annex III includes the list of abbreviations used in the evaluation.

2. Evaluation Summary

2.1 Paks Nuclear Power Plant

In 2020, 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 neither the employees of the nuclear power plant nor 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 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 2020.

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" significantly degraded, while the area of "smooth operation" showed a slightly degrading tendency.

In 2020, **the area of smooth operation** was characterised by 1 green, 3 yellow and 2 red indicators. In comparison with the preceding year, the number of red indicators increased from 0 to 2, the number of yellow indicators increased from 2 to 3, while the number of

green indicators decreased from 4 to 1. Among the 17 safety attributes providing basis for the indicators 10 were green, 5 were yellow and 2 were red. Among the attributes, the qualification of none improved, 13 did not change and 4 degraded in comparison with the preceding year.

- The *"Maintenance planning"* indicator was red since 2017, but it improved to yellow in 2019, and this qualification remained in 2020. The contributing *"Ratio of performed and planned work orders"* attribute and the "*Ratio of planned and real length of main overhauls"* attribute remained yellow.
- The qualification of *"Use of load cycles"* attribute remained yellow, the *"Foreign materials"* attribute degraded to yellow, thus the *"Material condition"* indicator remained 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 improved to green in 2019, then degraded to red in 2020 due to the degradation of the *"Immediate reportable events"* attribute to red.
- The *"Unplanned shutdowns and power reductions"* indicator degraded to yellow in 2020 due to degradation of the *"Power reduction due to internal causes"* attribute to yellow.
- The *"State of the barriers"* indicator degraded to red in 2020, due to the degradation of the *"Fuel reliability"* attribute to red.
- The *"Repairs"* indicator kept its green qualification.

The **area of operational safety** was characterized by 5 green and 2 yellow indicators in 2020. As compared to the previous year one indicator changed from red to green, two indicators from green to yellow, while all the rest remained green. Among the 19 safety attributes composing the indicators 17 are qualified as green. 2 attributes degraded, 1 attribute improved, while 16 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, then it became green again in 2020.
- The "*Environmental risk"* indicator was green since 2015, it became yellow in 2018 due to degradation of the *"Liquid radioactive waste"* attribute to yellow, but it improved back to green again in 2019. In 2020, it became yellow again as the *"Generated high activity solid waste" attribute degraded to yellow.*
- 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, which was sustained in 2020.
- The *"Emergency preparedness"* indicator has been green since 2006.
- The *"Risk during operation"* indicator was qualified as green already for five years, then became yellow due to the degradation of *"OLC violations" (Operational Limits and Conditions)* indicator to yellow.

The area of commitment to safety, in 2019, was characterised by 5 green, 1 yellow and 3 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 13 green, 4 yellow and 5 red attributes among those 22 safety attributes that provided basis for the indicators. Among the attributes, 2 improved, 4 degraded and 16 remained unchanged in comparison with the preceding year.

- The *"Deviation from planned state"* indicator was red in the last three years. The *"Number of modifications of the Operational Limits and Conditions"* attribute is green and the *"Temporary modifications"* is yellow in 2020, the *"Temporary deviations from the OLC"* and the *"Operational instructions"* attributes remained red, 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 2020, however the *"OLC violations"* attribute degraded to yellow.
- The *"Deviations in the reporting system"* indicator was six times red and for four times yellow of the 10 years between 2008 and 2017. The *"Delay in the submission of event investigation reports"* attribute and the *"Delay in reporting of non-immediate reportable events"* attribute degraded to red, while the *"Delay in reporting of immediate reportable events"* attribute improved to yellow, so the indicator remained red in 2020.
- The *"Radiation protection programme effectiveness"* indicator remained green in 2020.
- The *"Industrial safety programme effectiveness"* indicator has been qualified as green since 2018.
- The *"Human factor"* indicator had been green for four years, but due to the degradation of the *"Events entailing personal error"* attribute the indicator degraded to red.
- The *"Self-assessment"* indicator has been green as of 2007.
- The *"Corrective measures"* indicator improved to green, since the *"Corrective actions of quality assurance related audits"* attribute improved to green.
- 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 2020.

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 2020, a critical safety attribute was identified as the *"Operational instructions"* attribute was red in the last three years.

Events

In 2020, 19 reportable events occurred, including 11 immediately reportable events. The number of immediately reportable events showed an increasing trend in the recent years. The number of non-immediately reportable events significantly decreased. In 2020, an event with AP1 (Accident Protection) actuation occurred once, in addition to two events

with AP3 actuation. Human or documentation error was identified as root cause of reportable events six and three times by the investigation. The authority determined seven events as reoccurring events. Real ECCS (Emergency Core Cooling System) actuation did not occur in 2020, natural phenomenon did not cause any event, and no event related to radiation safety occurred during the year.
The HAEA 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. There was no significant event from the risk increment point of view.

It can be stated based on the safety evaluation of the events that the number of reportable events increased, while the number of events entailing AP1 actuation, and of events entailing the inoperability of two safety systems decreased in comparison with 2019. 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. During the operation of the nuclear power plant the provisions of the OLC was violated once in 2020. Events entailing ECCS operation has not occurred since 2014. There was no radiation safety related event in 2020. 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.

Inspection
In 2020, 257 inspections were recorded at Paks Nuclear Power Plant, including 143 on-site inspections, 66 delivery-acceptance, 21 clarifications of cases and 27 times the acceptance of the Documentation Substantiating the Operation After Modification. Due to the impacts of the pandemic, the number of on-site inspections significantly (with 41%) decreased, they were replaced by remote data verification and the inspection of the data of station computers. Additionally, in order to reduce the spread of infection, the face-to-face inspections were replaced by acceptance-delivery of appropriate documents of compliance and their authority review.

During the inspections, there was no need for any immediate action or intervention to the operation.

Due to the impacts of the pandemic, the HAEA postponed its planned comprehensive inspection to 2021, the scope of which will cover technical issues related to main overhauls and modifications.

Licensing
The HAEA, in the frame of its public administration proceeding and oversight activity associated with nuclear safety of nuclear facilities, made 326 regulatory decisions in 2020, including 171 conclusive decisions and 155 procedural decisions.

With regard to practices of profession the HAEA made 136 decisions, 48 out of which were for the application of Paks Nuclear Power Plant.

The number of conclusive decisions related to Paks Nuclear Power Plant is more or less the same as in 2019, only two more were issued than 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 PSR tasks.

Nuclear Emergency Response
Paks Nuclear Power Plant performed only those nuclear emergency response exercises that could be conducted in compliance with the medical requirements of the pandemic, including physical distancing, ban on staying more than 10 workers in a closed space, mask wearing. The exercises went well, the established objectives were fulfilled, issues were not identified, the operability of the Emergency Response Organisation (hereinafter referred to as ERO) was demonstrated.

Organisational Factors
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. Based on the annual inspection plan, the HAEA inspected the training system. The representatives of the HAEA always participated in authorizing exams, and recorded their experience in inspection records. It was concluded during the inspections that the organization, conduct and documentation of the exams followed the effective requirements. The experience gained during the exams were analysed, and measures were taken, as appropriate.

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.

Enforcement
In 2020, the HAEA initiated one enforcement proceeding that was closed within the year. During the main overhaul of Unit 1, a plate part was found in one of the steam generators,

which had to be reported to the HAEA in line with the rules for eventual reporting as a foreign material found in a safety important system. The licensee missed the reporting obligation, thus the HAEA sent a warning to Paks Nuclear Power Plant and obliged it to review its internal procedure and to report the finding of any foreign material in a safety important system to the HAEA according to the rules on rapid reporting requirements.

In summary, it can be stated that during its regulatory activities the HAEA did not identify such an issue which might jeopardise safety, thus, beyond the above enforcement action, immediate authority intervention was not justified.

2.2 Spent Fuel Interim Storage Facility

Based on the evaluation of safety performance of the SFISF in 2020, 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 very 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 2020, in comparison with 2019, enhanced in the areas of „Smooth operation" and „Operation with a positive safety attitude".

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

In 2020, the SPIS of the SFISF was composed of 9 green and 1 yellow indicators. Among the attributes 18 were green and 1 yellow.

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, then it improved back to green in 2020. 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 *"Human factor"* indicator changed yellow from the red of 2019 due to the improvement of the *"Violation of requirements"* attribute. 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 fifth 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 2020, no reportable events connecting to construction activities occurred.

Licensing

The HAEA made 9 conclusive decisions and 11 procedural decisions related to the facility in 2019. The subjects of the decisions were related to the modification license for moving spent fuel assemblies between storage tubes at the SFISF, approval of the new version of the Workplace Radiation Protection Rules (WRPR), extension of the validity of authority examinations, approval of the new version of the rules of authority examinations, fix time exemption from certain requirements of the Govt. decree 118/2011. (VII.11.) Korm., manufacturing license for loading decks and civil structure connection elements of expansion in Phase 3 Stage III of the SFISF, new operating license, extension of the validity of the construction license of the Back-up Command Centre of the Central Alarm Station, and one decision concluding enforcement procedures. The procedural decisions were related to calling for supplements, requesting co-authority opinion, and in one case launching procedures ex officio.

Inspection

In 2020, the HAEA conducted four nuclear safety inspections at the SFIS. The HAEA paid special attention to the inspection of the inactive test of the assembly transfer between storage tubes within the facility, and the large sample concrete filling experiment connecting to the manufacturing licensing proceeding of the loading decks and civil engineering connecting elements of the Stage III Phase 3 expansion of the SFISF. Additionally, in line with the annual plan, the HAEA performed the general radiation protection inspection of the facility and the modification of the power connection system of the container carrying vehicle. Due to the pandemic, the HAEA postponed the performance of several (non-critical) inspections planned for 2020 at the SFISF (i.e. inspection of fuel assembly receipt, annual maintenance, inactive complex test).

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.

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

In line with the provisions of the NSC (Nuclear Safety Code), 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.

Organisational Factors
The HAEA inspected the training system based on its annual inspection plan. A representative of the HAEA always attends the authority licensing examinations and concludes the experiences in inspection records. It was concluded during the inspections that the organisation, conduct and documentation of the examinations were performed according to the effective provisions. The experience gained during the exams was assessed and measures were taken as appropriate. In line with the internal regulations, the professional areas of the licensee could make proposals for the topics of various courses. The HAEA stated in its procedural decision RHKK-HA0056 approving the new version of the authority examination that the licensee had not fully accomplished the review of the training materials as required by law, thus its accomplishment was prescribed as a licensing condition with the deadline of 2020. 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.

Enforcement
In 2020, the HAEA closed an enforcement proceeding that had been initiated in 2019, and initiated another one:

- As a conclusion of the enforcement proceeding initiated in 2019, in connection with partly the SFISF and partly the RWTDF, the HAEA stated that the PURAM Plc. Had not submitted the Modification Evaluation Reports of the modifications of the Emergency Response Plans of the SFISF and the RWTDF by the prescribed deadline, thus it obliged the licensee to pay a penalty of 350 thousand HUF.
- The HAEA initiated an enforcement proceeding in 2020, because the PURAM Plc had not handled as modification the replacement of a hand-foot monitor and a vehicle radiation portal monitor by newer types.

In summary, it can be stated that the HAEA did not identify such an issue which might jeopardise safety, thus immediate authority intervention, beyond the enforcement actions described above, was not justified.

2.3 BUTE INT Training Reactor

Based on the evaluation of the safety performance of the BUTE INT TR in 2020, 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 Technical Specifications (hereinafter referred to as 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" improved, and "operation with a positive safety attitude" moved 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 2020, the SPIS consisted of 10 green and 2 yellow indicators. Among the safety attributes, 21 were green and 3 were 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 improved to green due to the green 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 since 2015, because the *"Number of safety protection system failures"* attribute became green again based on the data of 2020. 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 yellow due to the yellow qualification of the *"Number of violations"* and *"Events due to human errors"* attributes. The *"Radiation protection programme effectiveness"* indicator remained yellow, because the degradation of the *"Eventual reports regarding radiation protection"* attribute from green to yellow, even if the *"Individual dose"* attribute improved from yellow to green. 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 TUBE INT TR in 2020.

Licensing
The HAEA made 5 authority decisions regarding the BUTE INT Training Reactor in 2020. In the modification licensing proceeding connecting to the reconstruction of the radiation protection monitoring system of the Training Reactor, the HAEA issued 2 conclusive decisions (including one with regard to requesting environmental protection co-authority opinion in an issue on dispersion) and 1 procedural decision. In connection with the MER of the ERP of the TR, the HAEA issued 1 conclusive decision and 1 procedural decision in 2020. 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 2020, at the BUTE INT TR, the HAEA performed 9 out of the 10 inspections planned for 2020 (one inspection was postponed due to the pandemic), including 5 nuclear safety related inspections. Following the lift-up of the spring pandemic restrictions (in July-August), the authority performed an on-site radiation protection inspection, a general building authority inspection, inspection of the modification of the radiation protection monitoring system, and the comprehensive regulatory inspection of the TR, including 4 part inspections (its scope, beyond those listed before, covered organisational and decommissioning issues, and the technical condition of the building). As pandemic restrictions were enforced in September, the Authority assessed and evaluated the summer maintenance of the facility (Aug 31 – Sept 4) by documentation inspection.

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.

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 an exercise involving the entire organization on September 12, 2019, thus it was sufficient to organize an exercise involving only the facility emergency response organization in 2020. On August 4, 2020 an alerting drill was held that was used, among others, for the evaluation of the effectiveness of the facility Emergency response Plan that had been modified in 2019. Based on the assessment of the licensee, the exercise was successful, its documents were submitted to the HAEA. The HAEA evaluated the exercise through inspecting its documents.

Organisational Factors

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 could also suggest training topics. The review of the training material was performed in line with the internal regulations. It is worth highlighting that the replacement of leaving professionals mean a continuous challenge, the position requiring special professional knowledge is not easy to be filled from the labour market.

Enforcement

The HAEA did not initiate any enforcement proceeding regarding the facility in 2020.

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 2020, 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 improvements are visible in the areas *of "smooth operation"* and *"operation with low risk"*.
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.

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

In 2020, the SPIS of the BRR consisted of 1 red, 1 yellow and 11 green indicators. Among the safety attributes, there were 1 red, 1 yellow and 28 green. Comparing to 2019, the qualification of 1 attribute improved from yellow to green, 3 attributes degraded from green to yellow, while 1 attribute degraded from green to red.

In, 2019, 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 and degraded from green to yellow, thus the *"Operating characteristics"* indicator became also yellow, then the attribute and thus the indicator improved to green in 2020.

In 2019, 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, then both the attribute and the indicator improved to green in 2020. Other indicators, namely the *"Releases" and* the "*Safety 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. Following two years improving tendency in 2017 and 2018, the attribute got red qualification in 2019 and 2020. The authority continues to pay attention to the area: the authority evaluated the area in detail in the frame of its comprehensive inspection, and requested an action plan from the licensee to eliminate the identified deviation.
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 and 2020. In order to investigate the non-conformance, the HAEA planned an on-site inspection for 2020 at the facility, but due to the pandemic, it was postponed to 2021.
The *"Radiation protection programme effectiveness"* indicator remained green since the improvement of *"Radiation protection related event reports"* attribute to green in 2019.
The *"Operating experience feedback"* and the *"Industrial safety programme effectiveness"* indicators have been maintaining the green value for years.

Events
In 2020, 3 reportable events occurred at the BRR.

Licensing
The HAEA concluded 9 authority decisions in association with the BRR in 2020. The HAEA closed the modification of the Workplace Radiation Protection Rules by a procedural decision. The HAEA issued 2 conclusive decisions and 1 procedural decision in the approval proceeding of the fuel transport ERP of BRR. In the modification licensing proceeding of the reconstruction of the automatic control system, a conclusive decision preceded the licensing procedural decision. Following the assessment of the report on the evaluation of the condition of the control rods of the facility prepared by the licensee and requested to be submitted by the HAEA, the HAEA initiated an in-officio public administration proceeding to require the replacement of the control rods, including the issuance of 2 conclusive decisions and 1 procedural decision.

Inspections
In 2019, the HAEA conducted 11 on-site inspections, including 5 nuclear safety inspections at the Budapest Research Reactor. In addition to the annual inspection plan of the HAEA,

the supplier of the fuel elements was inspected at the manufacturing facility. In accordance with the annual inspection plan, the HAEA inspected the fuel delivery-acceptance during the summer, the replacement of control rods as a part of the inspection of the summer maintenance of the BRR, and on the site the summer maintenance activity of the facility. In December 2020, the HAEA connected, in the form of remote inspection, to the table top ERP command exercise of the licensee conducted on-line due to the pandemic.

Immediate action or request for operational intervention was not justified during the inspections.

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 full scope exercise planned for 2020 was transferred, due to the pandemic, in agreement with the HAEA, to an on-line table top exercise that was remotely inspected by the HAEA. The exercise 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 Emergency Response Organization.

In 2020, after meeting the relevant legal requirements, the HAEA approve the fresh fuel transport Emergency Response Plan of the BRR.

Organizational Factors
Based on its annual inspection plan, the HAEA inspected the training system and the internal dosimetry exam of 2 dosimetry candidates as a part of the inspection of the facility radiation protection organization. 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.

Enforcement
In 2020, the HAEA did not initiate any enforcement proceeding regarding the facility.

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 2020, 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 2020, only one reportable event occurred during the operation of the NRWR.

Licensing

In 2020, in connection with the NRWR, based on the submitted documents, the HAEA granted three licenses (regarding additional activities planned on the HUBTEX forklift, the modification of this modification license, and the approval of the Workplace Radiation Protection Rules) and commenced the safety evaluation of another planned modification

regarding the modification license application of the NRWR operating license. (planned modification activities on the DKS-160 HUBTEX trolley).

The HAEA issued the approval of the methodology of release from regulatory control under the effect of Govt. decree A 487/2015. (XII.30.) Korm.

Inspections
In 2020, the HAEA performed 5 on-site inspections at the NRWR documented in inspection records. Out of them 2 inspections were related the operation of the repository, while 3 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 due in 2020 at the NRWR, but it was postponed by the facility to 2021. The NRWR conducted two exercises in 2020, including an alerting drill and the 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.

Enforcement
In 2020, the HAEA commenced an enforcement proceeding regarding unlicensed activities performed on the HUBTEX DKS-160 forklift, lack of independent internal supervision during the modification, lack of comprehensive documentation and violation of internal regulating documents. The HAEA obliged the PURAM Plc to eliminate the deficiencies and to pay financial penalty.

In summary, it can be stated that the HAEA did not identify such an issue which might jeopardise safety, thus immediate authority intervention, beyond the enforcement action described above, 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 2020, 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
In 2020, two reportable events occurred at the RWTDF.

Licensing
In 2019, in connection with the RWTDF, based on the submitted documents, four regulatory licensing proceedings were closed with the issuance of licenses under the effect of the Govt. decree 155/2014. (VI.30.): utilization license of civil structures required for the implementation of safety improvement measures of the RWTDF, modification license to the Emergency Response Plan of the RWTDF, modification license to the monitoring programme of the RWTDF, and the approval of the Workplace Radiation Protection Rules of the RWTDF. The HAEA closed the licensing proceedings by approving the methodology of release from regulatory control under the effect of Govt. decree A 487/2015. (XII.30.) Korm.

Inspection
In 2020, the HAEA performed 4 on-site inspections at the RWTDF in Püspökszilágy documented in inspection records. Out of them 2 inspections were related to preparatory activities for the Safety Improvement Measures planned on the site, 1 to the Emergency Response Plan of the facility and 1 to the storage of radioactive source, radioactive material.
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 in the case of the RWTDF, but it was postponed by the facility to 2020 and performed in December 2020. Taking account of the pandemic situation, in 2020, the RWTDF conducted a two-stage exercise consisting of the alert of the ERO and a table top exercise ERP. Both exercises were qualified as „appropriate".

Organizational Factors
Based on the annual inspection plan, the HAEA inspected the training system. It could be concluded during the inspections that the organization, conduct and documentation of the trainings were performed in line with the valid provisions. The training materials were reviewed in line with the internal regulations.

Enforcement
In 2020, an enforcement proceeding was initiated as a consequence of an event occurred at the site of the RWTDF. On July 15, 2021, the representatives of the HAEA conducted an unannounced on-site inspection regarding the modification of ERP 5.1. The inspection revealed that the RWTDF entered the RWTDF ERP 5.1 into force beyond the validity of the procedural decision approving the modification (May 31, 2021) on June 19, 2021. In

addition, at the time of the inspection, the document was not accessible on the site as a printed version, and the employees were not received training on the changes comparing to the previous version. Consequently, the HAEA obliged the licensee to pay a fine as a result of an enforcement proceeding.

In summary, it can be stated that the HAEA did not identify such an issue which might jeopardise safety, thus immediate authority intervention, beyond the enforcement action described above, was not justified.

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 under the effect of the Atomic Act after the site survey and assessment license was granted to it in 2014, then it obtained the site license for the construction of new nuclear power plant units in 2017.
The next milestone of the realization of the project will be the construction license to be granted by the HAEA, as this will license Paks II Ltd to apply for those additional licenses, which would allow commencing the actual construction, manufacturing, purchase and manufacturing works. In order to obtain the construction license, Paks II Ltd submitted its application for the construction license of nuclear power plant units 5 and 6 at the Paks site in June 2020, and requested (in the same application) the designation of the safety zone and the approval of the preliminary nuclear emergency response plan.
One of the basic documents of the construction license application is the Preliminary Safety Report, in which Paks II Ltd has to demonstrate that the nuclear power plant planned to be constructed complies with the nuclear safety requirements by the designed engineering arrangements, technical solutions and operating methods, and can be safely built and operated.

Figure 2.7-1: Design view of the new units (Source: http://www. paks2.hu/)

Events
No event occurred in 2020 at Paks II. Ltd.

Licensing

In 2020, the HAEA issued altogether 12 building licenses in connection with the construction of the new nuclear power plant units (among others for the metal warehouse, the workshop manufacturing metallic products, the administration and service building of the metal assembly facility, the control building of the concrete mixing facility and the connecting vehicle scale, the building of the concrete examination laboratory, the civil structures of the concrete mixing facility, civil structures of the complex required for performing corrosion resistance works, the restaurant and cooking kitchen for 500 people, and the construction of a service and change building for 500 people).

Paks II Ltd submitted its application for the construction license of nuclear power plant units 5 and 6 at the Paks site on June 30, 2020, together with the request for the designation of the safety zone and the approval of the preliminary nuclear emergency response plan.

In addition to the construction licensing proceeding of Units 5 and 6 to be constructed at the Paks site, separate proceedings were commenced for the evaluation of the preliminary nuclear emergency response plan and the designation of the safety zone.

The administrative deadline of these proceedings is 12 months, which might be extended by the HAEA with 3 months, if justified.

Furthermore, in 2020, Paks II Ltd submitted its application to obtain license of the physical protection plan of Units 5 and 6 to be constructed at the Paks site to the HAEA, and the licensing proceeding started based thereon.

Inspection

The HAEA performed 10 targeted inspections in 2020 at Paks II Ltd, including the inspection of the supplier qualification process, the construction works on the construction area of the project, and the management of requirements. During the inspections, immediate action did not become necessary.

Works were undisturbedly performed at Paks II Ltd during the pandemic, the pandemic restrictions did not hinder the construction activities. The building of the UYA 1.1.1 and 1.12 office buildings and the UYA 1.1.3 restaurant (with 100 seats) and kitchen continued in the construction area, and the building of the Plant Project Centre was started, which were inspected by the HAEA.

In the second half of the year, the HAEA, as a trial, performed a hybrid inspection, in the frame of which only one HAEA representative following the pandemic protective measures was present on the scene of the inspection, while all the others joined through an online video conference. The trial was successful and efficient, thus the HAEA will apply this method in the future.

Paks II. Ltd performed 54 supplier qualification and supervisory audits in 2020, including 7 with site audit and 7 with documentation review. The representatives of the HAEA

participated, as observers, in 3 site audits in the Russian Federation, 1 in Germany and 1 in Hungary.

Site audits had not been performed since March 2020. During the audits with documentation review only the documents were reviewed, and the issued qualification covered the preparation of the licensing documentation. The commencement of construction, manufacturing, purchase and assembly activities is banned by the condition of site audits.

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 2020, 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 IAEA (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	22	20

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.

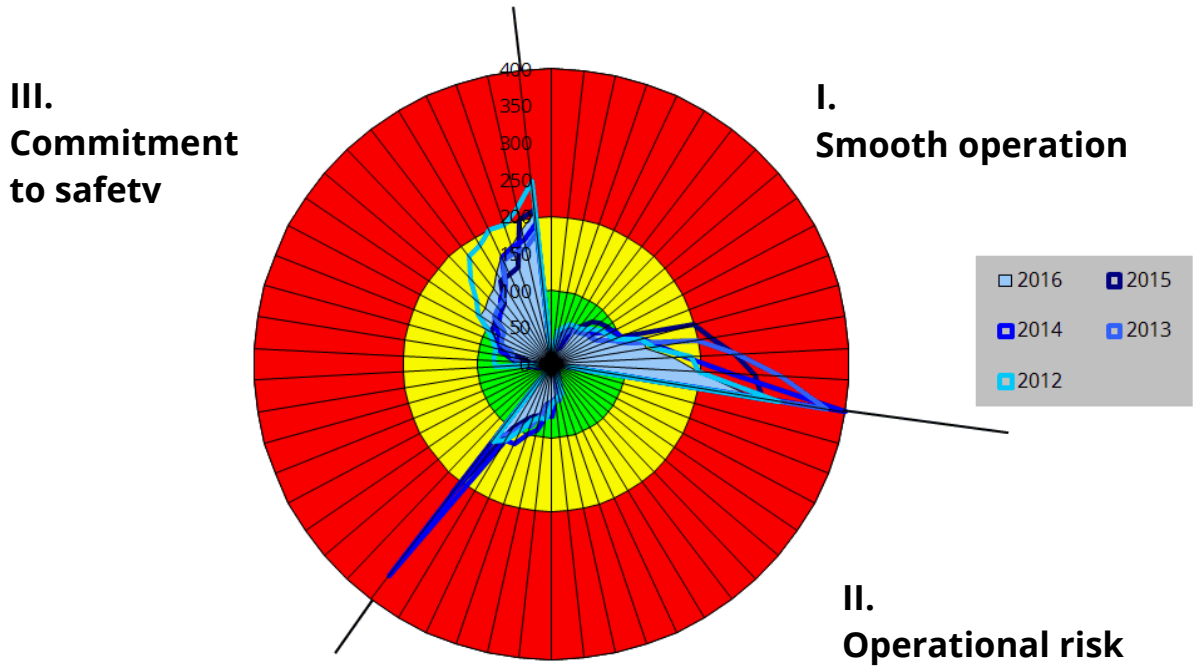

Figure I.2-1: SPI circle diagram

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 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
ECCS	Emergency Core Cooling System
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
NRWR	National Radioactive Waste Repository
NSC	Nuclear Safety Code
OLC	Operational Limits and Conditions
Paks NPP	Paks Nuclear Power Plant
PSR	Preliminary Safety Report
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
WPRPR	Workplace Radiation Protection Rules