REGULATORY ASSESSMENT OF HUNGARIAN NUCLEAR FACILITIES AND RADIOACTIVE WASTE REPOSITORIES IN 2014

Hungarian Atomic Energy Authority

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ABSTRACT

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Foreword

The assessment of activities of the nuclear facilities – beside the licensing and inspection tasks – belongs to the most important elements of regulatory oversight. One of the main duties of the Hungarian Atomic Energy Authority is to guarantee nuclear safety, prevent the occurrence of nuclear accidents within the framework of the law and using the resources that the Hungarian citizens provide it through their elected representatives. The Hungarian Atomic Energy Authority, as part of its nuclear safety oversight activity, annually evaluates the safety performance of the nuclear facilities and the safety level of the nuclear facilities' activity.

The main purpose of the assessment is to supervise and examine the operation of the facilities, reveal the deviations in the early phase with the aim of preventing them, discover their safety effect and causes and to initiate effective measures on this basis to eliminate the deviations.

The assessment carried out by the HAEA is based on a safety performance indicator system developed individually for each of the facilities, periodic reports of the facilities and on event reports aiming to investigate and eliminate the major deviations. The primary purpose of the annual assessment report is to provide a feedback for the licensees of nuclear facilities on the evaluation of nuclear safety related experiences achieved during the last year, primarily from the perspective of the effect of operation on the public, nature and workers of the facility.

In general, it can be stated regarding year 2014 that the nuclear facilities belonging to the HAEA's oversight domain – Paks NPP, Interim Spent Fuel Storage Facility, the Training Reactor of the Budapest University of Technology and Economics Institute of Nuclear Techniques and the Budapest Research Reactor – operated according to the prescribed conditions and parameters.

It can be stated on the safety performance of Paks NPP in 2014 that there was no significant change in two main assessment areas, and there was a small decline in the third one in comparison with the previous year. The total result of 2014 worsened a little in comparison with 2013, but even so it was the second best result in the history of the HAEA created safety performance indicator system. In contradiction to this the safety assessment of events shows the unfavourable result of safety performance which is similar to the last years.

The safety performance of the Interim Spent Fuel Storage Facility improved in comparison with 2013, but it is necessary to do further smaller interventions regarding the unsatisfactory low level indicators to raise the performance to a perfect level.

The safety performance of the Training Reactor of the Budapest University of Technology and Economics Institute of Nuclear Techniques has been stable good for years. It maintains an almost impeccable niveau in the other two areas.

The safety performance of the Budapest Research Reactor increased in two main assessment areas and remained unchanged in the third one in comparison with the values of previous year.

It is still an expectation that the licensees of nuclear facilities strive after preventing any deficiencies, maintain and enhance the level of safety and the safety culture. In order to support this effort, the regulatory oversight focuses on the deteriorating and unacceptable areas for screening, eliminating any negative tendencies.

In consequence of the changes in Act on Atomic Energy in 2013 the licensing and inspection of siting, commissioning, operation, modification and closure of radioactive waste repositories belong to the scope of competence of the Hungarian Atomic Energy Authority, as atomic energy oversight authority since June 30, 2014.

The HAEA has found on the basis of safety performance assessment of National Radioactive Waste Repository in Bátaapáti and Radioactive Waste Treatment and Disposal Facility in Püspökszilágy that the facilities operated according to the prescriptions. The construction of the safety performance indicator systems began, but they were not implemented yet for the radioactive waste repositories. However, in the submissions of regular reports, there was data on some of the intended safety performance indicators already available, and this data was presented in the annual reports. This establishes the basis for making comparison, trends and further adjustment of the indicator systems to be done in the future.

In addition to maintaining and enhancing the level of nuclear safety, the main next year duty of the Hungarian Atomic Energy Authority is to oversee the service life extension of the rest of Paks NPP units, the measures based on the Targeted Safety Re-assessment that reflected the Fukushima experiences, the new unit site characterization and assessment programme and to prepare for these activities. The employees of the authority readily undertake this responsibility in order to protect and keep safe the public and the environment and to prevent any event unfavourably affecting safety.

Gyula Fichtinger
Director General of Hungarian Atomic Energy Authority

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1. Introduction

The Act CXVI of 1996 (Act on Atomic Energy) regulates the essential tasks and duties of the Hungarian nuclear facilities and the authority, the Hungarian Atomic Energy Authority (HAEA), supervising them.

Following the prescriptions of the Act on Atomic Energy the HAEA annually evaluates and assesses the safety performance of the nuclear facilities in its scope. The main purpose of the assessment is to provide feedback for the Licensee of the nuclear facilities on the regulatory opinion on the nuclear safety related events to facilitate the maintenance and advancement of nuclear safety.

The **safety** has priority over every other aspect in operation of nuclear facilities. The essential goal of regulatory supervision of the use of atomic energy is that no harm of human and environment shall be caused in any way by the use of atomic energy. It is a further concern that the supervision should not restrict more than reasonable the operation of the facilities, and equipment posing the risk and carrying out of activities.

The assessment of safe operation is carried out along with complex, quantitatively expressible attributes, the so-called safety performance indicators. Beside these safety performance indicators, the regulator also uses the conventional engineering and safety assessment methods, because the safety performance of the facilities is stated only as a result of the complex assessment. In many cases only a comparison with the conclusions and safety indicators of the previous years' yields the desired results.

The inputs of the safety performance assessment are the regulatory inspection results, the operational data, the investigation and analysis of events occurred during operation. For this purpose the HAEA:

- Collects operational data, makes trends;
- Investigates and assesses the events occurred in the particular year,
- Performs safety assessment of the events
- Carries out probabilistic analysis of events, examines especially the recurrent events and those ones caused by a human failure,
- Evaluates the safety performance in general with the help of the safety performance indicator system.

During the safety performance assessment of the facilities under its surveillance the HAEA takes into account their potential hazard level.

The HAEA defines the assessment criteria of safety performance in a way to take into account the achieved level of safety performance of the nuclear facility, the national and international experience related to use of atomic energy and to support the licensee to enhance its safety performance.

The first chapter of the assessment is the present introduction; the second chapter includes the assessment summary of each facility. In its first subchapter there is a detailed evaluation of Paks NPP according to the safety performance indicator system. The subchapter also includes the safety assessment of the events occurred in 2014 in the nuclear power plant and the description of the significant regulatory activities related to the facility. The second to sixth subchapters include detailed assessments based on Safety Performance Indicator System of the facilities, respectively: Interim Spent Fuel Storage Facility (ISPSF), Training Reactor of Budapest University of Technology and Economics Institute of Nuclear Techniques (BUTE TR), Budapest Research Reactor (BRR), National Radioactive Waste Repository (NRWR) and Radioactive Waste Treatment and Disposal Facility (RWTDF).

The regulatory assessment methodology is written in Appendix I. Appendix II includes the most important data of the regulated Hungarian facilities.

2. Assessment summary

2.1 Paks Nuclear Power Plant

The facility basically operated in 2014 **according to prescriptions**. The **values measured during environmental discharge monitoring**, according to previous years, were **below the regulatory limits by several order of magnitude**.
The **occupational dose exposure** (the collective dose and maximal individual dose) is **commensurable with the previous years**. **Neither the regulatory dose limit of employee** (50 /a) or the facility's goal on individual dose (20 mSv/a) **was exceeded**.

Picture 2.1-1: Paks Nuclear Power Plant (Source: www.atomeromu.hu)

Safety Performance Indicator System

Regarding the safety performance reflected by the safety performance indicator system[1], based on the low level safety performance indicators and the safety performance indicators gathering them up, it can be determined that there was no significant change in comparison with the previous year on the areas „Smooth Operation" and „"Safety Culture. On the area „Safe Operation" showing better general performance, there is a small fallback.

[1] See Appendix I on methodology of regulatory assessment.

On the area **smooth operation**; there were two red indicators in 2013 and 2014:

- The „*systematic arrangement of maintenance*" indicator has a lasting bad qualification due to „*ratio of work-instructions beyond plan*" low level indicator that examines the deviations from maintenance plan. First due to delay of design/planning and licensing processes during preparation, some works can be planned only as extra works after maintenance schedule is finished. In addition, the value of the low level indicator was degraded by the amount of unforeseeable works rising up during main outage. The licensee does significant effort in order to press back the extra works, but a visible result in qualification of the indicator is further expected.
- The „*condition of physical barriers*" indicator declined from good qualification in 2013 due to „*fuel reliability*" low level indicator. It is the result of the fuel leak problems arisen at unit 1.

No red indicator has been experienced in the area **safe operation** for three years, but the number of yellow indicators increased in comparison with 2013 at the expense of the green ones:

- The „availability factor" indicator declined due to fall-back of „unavailability detected during tests" low level indicator.
- The „environmental risk" indicator declined due to degradation of "new, high activity, solid radioactive waste" low level indicator. It must be noted that the amount of radioactive waste sometimes significantly changes year by year depending on the modification and maintenance works scheduled for the particular year.
- Since 2011, the „*operation risk*" indicator is at warning level due to „number of TechSpec violation" low level indicator having the value of 1 each year.

The „**safety culture**" field includes the low level indicators that make safety culture be expressed in measurable units. The judgement of safety culture standard is an extraordinarily hard and complex evaluation task. Rather the changes of the individual safety culture low level indicators can be expressed with the indicators. The Paks NPP has taken several measures in this field, but at the same time there are further significant must-does left according to regulatory expectations.
There was 1 red indicator in both 2013 and 2014:

- The „*deviations of reporting system*" indicator also has a lasting unsatisfactory qualification. The „*delay of immediately reportable event notification*" low level indicator was six times red and four times green in the last ten years. This random alternation is attributable to the low number of such events, typically 1-3 each year. One such event occurred in 2014, and the obligation to notify within 2 hours was not fulfilled.

The HAEA identifies each year the critical low level indicators of safety performance. These are the ones which have been exceeding the acceptable standards at least for three years. It must be noted that there is an improving trend in a number of critical safety performance low level indicators since 2007. There was only 1 such low level indicator left between 2011 and 2014. **In the last three years the „*ratio of work-***

***instructions beyond plan*" is the only one critical safety performance low level indicator.**

Events

In 2014 there were 18 reportable events according to Regulatory Guide 1.25. Only one event was among these immediately reportable according to Nuclear Safety Code 1.7.4.0900. The number of both event types decreased in comparison with the last year value.

Among the events, the violation of Technical Specifications (TechSpec) occurred once. There was no reactor trip. Human failures were identified by investigation in 14 events, which can refer to problems in written procedures or in safety culture. The HAEA categorized 7 events as recurrent events. There was only one case of real ECCS actuation since 1996; this occurred in 2014 in the cooled down state of unit 4 during a test. Natural phenomenon caused no event. There was one reportable event related to radiation safety in 2014. It occurred during a radiography examination.

Based on the experiences of previous years, the failures related to diesel generators must be pointed out. According to quarterly reports of MVM Paks NPP Plc., among events the diesel generator was the most frequently affected system with 7 cases in 2014 and 9 cases in 2013. In 2013, the HAEA initiated the review and assessment of the diesel generators availability based on operating experience with them (and with their auxiliary systems).

There are 6 events in the HAEA event register that can be attributed to the improper activity of the suppliers/contractors. Because of the recurrent problems the HAEA pays special attention to examination and management of issues related to suppliers' onsite activity and control. This was realized in 2014 in a comprehensive inspection in this field. Relying on its results, the regulatory body continues to closely follow the issue.

The HAEA and its TSO partner, NUBIKI, performed the probabilistic safety assessment of the reportable events of Paks NPP in order to reveal the impact of the events to the NPP safety in total and individually. Even the total core damage frequency increase at the units in the examined period is considered to be low, as the core melt index, calculated or complemented with risk increment due to events, stayed below the authorized limits.

The safety assessment of events does not show significant change in comparison with previous years. There is a further need to increase the efforts of the licensee to eliminate the deficiencies, to keep and improve the safety standard and a strong safety culture. Having been increasing for years, the regulation violations show that the safety culture improvement measures were not effective enough. The regulatory oversight focuses on the degrading or unacceptable fields.

Licensing

The HAEA made 167 decisions during its public administration processes and oversight activity related to nuclear safety of the facilities. Among the decisions there were 116 resolutions and 51 verdicts. The number of the decisions, in addition to being technologically difficult and having increased safety impacts, increased in comparison with the last year, but it did not reach the number of preceding year's decisions.

In case of nuclear facilities, the HAEA performs the first instance building authority activities. 25 decisions were taken with the contribution of auxiliary authorities in relation to construction and put in use. The issuance of put in use licences was also preceded by on-site walkdowns, in which the representatives of the concerned authorities and NPP experts took part.

Our most important activities related to regulatory decisions:

- Licensing of Paks NPP unit 2 design service life extension.
- Licensing process related to implementation of Paks NPP 15 months-long fuel cycle.
- Licensing of shipment of spent fuel damaged in 2003.
- Licensing of repair of main coolant pump components.

Among the licensed construction activities, the most significant ones are the continuation of building reconstruction and reinforcement, and the improvement of the fire barrier integrity.

Inspection

In 2014 the HAEA performed 2 comprehensive inspections in Paks NPP and took 28 records during them, while the number of ad-hoc inspections documented in records is 369. The regulatory body inspected in 157 cases the periodic tests of safety systems and components, the operational state of the units, the general technological situation, the modifications, and in 112 cases the main outage activities. There were 4 inspections of operational events.

During the inspections, there was no need for immediate actions, commanding interventions related to operation.

The nuclear safety inspectors conducted inspections of preliminary safety assessment of planned modifications in 204 cases related to licensing processes and in 52 cases the Documentation Substantiating the Commencement of Operation Following a Modification. In addition the HAEA inspected the engineering safety of pressure vessels in 44 cases. That meant examination of hundreds of documents.

The most important regulatory inspections in 2014:

Comprehensive inspection of onsite supervision of suppliers:

The licensee can contract suppliers in activities related nuclear safety in accordance with Govt. Decree 118/2011 (VII.11.) and its Annexes 2-9. Even in this case, the licensee is responsible for nuclear safety. Within the scope of a regulatory inspection, the HAEA examined how the supervision of suppliers involved in activities related to nuclear safety takes place and how the licensee's responsibility occurs in that processes.

The HAEA stated the MVM Paks Plc. implemented the most important elements for supervision of suppliers' activity and they are in use. The tasks and responsibilities are mostly defined, but there are many fields to improve. The HAEA identified the following significant problems: in some cases the priority of safety or in the priority determining process the primacy of the nuclear safety was not recognizable, the oversight activity of MVM Paks Plc. does not cover the inspection of subcontractors of contractors and there are deficiencies in assurance of working abilities (competence/qualification) of suppliers' employees.

In the HAEA's opinion the comprehensive inspection reached its purpose. The inspection identified the activities required to perform oversight of suppliers' activity and HAEA convinced of its operation. The revelation of identified deficiencies and the corrective actions related to them support the enhancement of the nuclear safety standard at MVM Paks Plc. The HAEA identified no deficiency that would have needed immediate regulatory action but initiated an action plan to eliminate the deficiencies.

Comprehensive inspection of management

Within the main process branch of safety management, the management of nuclear facility is one of the most important elements from point of view of nuclear safety. The HAEA pays special attention to this, and time to time HAEA examines the nuclear power plant management in the frame of a comprehensive inspection.

The purpose of the inspection conducted in 2014 was to overview the management of deficiencies discovered during previous inspections, the self-assessment and management review processes, improvement of management culture and quality assurance. As a special viewpoint the HAEA took into consideration during the inspection the past management of changes, modifications of the controlling agreement, management of service life extension of the units, impact of new unit construction in the neighbouring site and degradation of some safety performance indicators affecting management processes. In the inspection framework the HAEA inspectors interviewed seven members of NPP senior management.

The HAEA stated that external political and other effects do not jeopardize safety and operation. The authorization of the management is broad enough to perform licensees'

responsibility. In the field of human resources the nuclear power plant management provides the basic supply to operate safely and prepares itself to provide the human resources with the due competence for the new tasks. The implemented knowledge management and mentor system is a good tool to maintain institutional knowledge.

One of the most important challenges is to prepare for role of the operator of the new unit, that began, but it shall not jeopardize the safety of the units already operated even in the future.

The effect of production cost reduction can be identified as a similar danger that can disadvantageously affect safety. This all did not occur according to opinion of management, as cost aspects did not hinder the engineering safety developments and safety problem eliminations. At the same time safety modifications can keep on in some cases that is derived not only from effect of legal and administrative environment but it can be improved further with proper organization and in some cases with better spare parts supply. This statement is true even in spite of that the management determines suitable priorities to the tasks.

The inspection drew the attention that the NPP management has to manage more pragmatically the register of the problems detected earlier and being important from safety point of view. All significant safety problems existing on short or long term shall be listed in order to have always a comprehensive picture of safety.

It can be derived from nuclear safety legislation that the licensee shall be able to perform independent external communication. The internal regulation of the NPP and its owner must be developed in this field.

It is a question having been current for years and a problem to solve in case of new units how to administer the general designer function. Now this is performed by the NPP together with an external company. The system of equipment engineers is a proper answer to supplement the background engineer knowledge, but the NPP shall be able to maintain the necessary resources. A proper resolution related to the new units shall still to be found.

As an important part of maintenance of safety, the integration of technical databases was finished. Special attention shall be paid to their maintenance in the future too. The efficient use of base data engineers is an important element of it.

The leader's presence in the field differs directorate by directorate. It is a good practice that the management strives to take part in as many as possible walkdowns, but the way of documentation and management of results is not unified.

In general, the internal, independent audits work except for the self-assessment of Directorate of Finance.

The HAEA considers as a good practice the prohibition of creation of a subcontractor chain and the system developed to manage the events of low significance.

The HAEA considers the results achieved in operational safety culture as pointing ahead. At the same time it is important to achieve results in the field of suppliers' safety culture. To improve that, the experience of on-site management inspections, workplace handing and taking over shall appear in the evaluation of suppliers' performance in a more determined and distinguished way.

The need of ability to screen out fake products is a relatively new but urgent challenge. The respective internal regulations shall be established.

The on-site part of the comprehensive inspection did not reveal such a nuclear safety problem that would have needed urgent regulator action. The regulatory body invited the licensee to prepare and submit a plan to manage the mentioned problems.

Inspection of conducting the Targeted Safety Re-assessment action plan

The Council of the European Union concluded on March 25, 2011 after the accident occurred in Fukushima Nuclear Power Plant that the NPPs in the European Union shall be subjected to a comprehensive safety reassessment on the operation risk. The whole process was required to be public. The widely known name of the process was the „stress tests" while and the Hungarian official one was „Targeted Safety Re-assessment" (TSR). The countries submitted National Reports including the review results to the Council of the EU in December, 2011. The HAEA ordered 46 safety improvement actions in the resolution related to the review. The HAEA watches the carrying out of the TSR action plan with special attention.

The inspections related to the TSR conducted in 2014 stated that 13 of the 46 ordered actions were already fulfilled, further 6 action were reported to be carried out and being assessed by the HAEA. Until now the MVM PA Plc. kept the deadlines specified in the TSR resolution. Majority of the actions were carried out pro-rata. But the inspection revealed 4 actions which were already beyond the deadline. In 4 other cases factors were identified that can jeopardize the fulfilment in time. However, there are some actions that were completed already well before deadline. The HAEA commanded in a letter how to manage the deficiencies and required the MVM PA Plc. to submit a safety analysis of risks originating from delays. The HAEA will take the necessary actions depending on the analysis result.

Inspection of improvement of Maintenance Effectiveness Monitoring (MEM) implementation at MVM Paks NPP Plc.

The HAEA Guide 4.6 (NPP maintenance programme and the maintenance effectiveness monitoring) defines the requirements of Maintenance Effectiveness Monitoring related

to NPP components categorized into safety classes. The regulatory inspection of MEM is described in Guide 1.19 (Inspection of effectiveness of NPP maintenance programme).

The general purpose of MEM is to justify that the performed maintenance activity provides for reaching the maintenance goals determined for the systems, structures and components subjected to maintenance or in case of deficiencies the carrying out of necessary actions. The use of the system began in Paks NPP in 2008.

As a first step it was necessary to create a database duly arranged to carry out the data collection belonging to the large scope of components subjected to MEM. The population of the database is going on. The maintenance goals related to components and the parameters proving their fulfilment were recorded in the database. For supporting the management of component parameters in the frame of MEM, the monitoring and inspections done by the system engineers, it is necessary to develop reporting interfaces with queries adjusted to the database and make the documentation and alerts possible on particular needs. The MEM inspection in 2014 pointed out that there are still delays in carrying out the work plan and the schedule, but none of them needed immediate regulatory intervention. The regulatory body still must pay special attention to this field.

Inspection of progress of modification of essential service water (ESW) pipelines with a nominal diameter larger than 200 mm

The HAEA observes with special attention the condition of the ESW pipelines with a nominal diameter larger than 200 mm. During the inspection, the HAEA examined the scope and schedule of the ESW system reconstruction, inspected the works going on and assessed their compliance. The HAEA stated the reconstruction shall not be delayed and it is necessary for the HAEA to further and continuously inspect the works conducted in the scheduled way.

Inspection of spent fuel pool leakage

The HAEA observed with special attention the out of turn inspections of unit 1-4 spent fuel pools performed by MVM Paks NPP Plc. due to detection of a leakage in unit 3 spent fuel pool in 2013. The HAEA approved the licences necessary to arrange the safe plant conditions for the inspection and supervised the activities on-site. The HAEA confirmed in inactive conditions the suitability of the inspection equipment developed for non-destructive tests of the pipelines. The HAEA approved and supervised on-site the repair technology of failures identified during the non-destructive material test of unit 3 spent fuel pool cooling pipelines. The adequacy of repair is justified as in the period since the continuous inspection and water level monitoring signalled no leakage.

2.2 Interim Spent Fuel Storage Facility

On the basis of the safety performance of ISFSF in 2014 the HAEA states that the facility **operated according to the legislative prescriptions**. The fulfilment of obligations ordered by the regulatory body suffered no delay. The operation of the facility **meant no health risk increase either to ISFSF employees or the public**. The value of occupational dose exposure is comparable with the values of previous years; the radioactive discharge was favourably low and remained significantly below the authorized limits. The operation of the reactor was performed in accordance with the prescriptions and following the Technical Specifications (TechSpec).

The performance reflected by the safety performance indicator system decreased in a main assessment field (due to one declining low level indicator), remained acceptable in another field and improved to acceptable in the third field for all low level indicators after one low level indicator improved.

Picture 2.2-1: ISFSF view (Source: http://www.rhk.hu/letesitmenyeink/kkat/a-kkat-uzemeltetese/)

In case of **smooth operation** there was over-planning detected in 2012-2014 related to „*suitability of loading time planning*"; the planned and factual time diverted from each other. The experiences pointed that the loading takes much less time than planned. Its reason was clarified during inspection, and therefore the HAEA and PURAM initiated the review of the indicator in 2015 second half. In addition, the „*suitability of gas supply systems*" low level indicator of „*condition of systems and equipments*" indicator showed a smaller decline. In case of the third low level indicator, „*suitability of installed radiation protection system*", there is a good performance level following the improving trend of

the last years. The other indicators of the field („*storage attributes*", „*events*") have been acceptable for years.

The **low level indicators of safe operation** field („*environmental risk*", „*risk*") have been acceptable in the last years.

In the field of **safe operation**, it deserves special attention that the number of „violations" significantly increased due the delayed fulfilment of regulatory obligations in 2013, which was the highest value of the last 9 years. It became lower and acceptable in 2014. The regulator initiated the revelation and elimination of the deficiencies. In order to reach that the HAEA conducted an inspection to determine the number of prescription violations. During it the registers of HAEA and PURAM were cross-checked. It is expected that the regular cross-checking will support the lasting acceptable qualification of the low level indicator. The „collective dose" became the lowest of the last 10 years. The other indicators, „*striving for improvement, self-assessment*", „*experience feedback*", „*radiation protection effectiveness*" and „*industrial safety program effectiveness*" have been acceptable since the beginning of the examined period.

Events
No reportable event related to TechSpec violation, TechSpec taking effect and to radiation safety due to natural or other phenomenon occurred in 2014 in the ISFSF.

Licensing
In case of ISFSF the number of decisions increased in comparison with the last year. The HAEA released 10 decisions related to ISFSF. The most important decisions were related to the processes of extension works, but a group of decisions in case of this facility were necessary because of elimination of deficiencies identified during inspection or maintenance of components or replacement with more modern or newer types of them.

The most important decisions referred to facility extension. The construction and commissioning of the vaults providing interim spent fuel storage is carried out in a modular way. It is necessary to extend the ISFSF with further vaults in order to host the spent fuels originating from the further long term operation of Paks NPP units. The HAEA published three resolutions (HA5837, HA5847 and HA5874) related to manufacturing of mechanical and other components of ISFSF phase 3 of installation 2 constructions.
The licensee initiated the modification of ISFSF vaults 1-20 operation licence (resolution HA5674) in order to host the fuel assemblies of type Gd-2_4.7 planned to introduce at Paks NPP. The HAEA released the new operation licence (HA5828).

After having been fulfilled the supplement ordered in a procedural decision, the HAEA released a modification licence (HA5803) for the Final Safety Report Chapter 13.2 (Training and qualification of staff, registry of training programmes). With the modification of the FSAR and the related internal procedures, the ISFSF fulfils the

changed prescriptions of the Decree 55/2012 (17.11) of Minister of National Development on the special professional training, further training of workers employed at a nuclear facility, and on the employees having the right to conduct activities in relation to use of atomic energy.

In addition the HAEA released 4 procedural decisions which modified administration deadlines or ordered the licensee to supplement its submitted documents in relation to licensing processes.

Inspection

The HAEA performed five inspections in the facility in 2014. Two inspections referred to a power supply failure during maintenance, one was related to welding tests of the storage tube manufacturing of the ISFSF Phase 3 of Installation 2; one was on the failure of total beta activity concentration measurement and one on the fuel assembly loading. There was no need to order regulatory action during the inspections.

It can be stated that the safety performance of the nuclear facility improved in 2014 in comparison with 2013. But the authority is on the opinion that further actions are necessary concerning unsatisfactory low level indicators in order to enhance the performance to unexceptional level.

2.3 Training Reactor of Budapest University of Technology and Economics

On the basis of the safety performance of BUTE TR in 2014 the HAEA states that the facility **operated according to the legislative prescriptions**. The operation of the facility meant **no health risk increase either to TR employees or the public**. The value of occupational dose exposure is comparable with the values of the previous years; the radioactive discharge was favourably low and remained significantly below the authorized limits. The operation of the reactor was performed in accordance with the prescriptions and followed the Operational Limits and Conditions (OLC).

The safety performance reflected by the safety performance indicator system is stable good at one main assessment field and good at the other two fields, with one-one exception of low level indicator at both fields.

Picture 2.3-1: Budapest University of Technology and Economics, Training Reactor, control room (Source: Pictures IAEA EURASC meeting)

The **smooth operation** has been stable acceptable for years. All indicators of the field, „*operational indicators*", „*condition of systems and components*" and „*safety barriers*" have been showing favourable standard from the point of view of safety. The number of „*reportable events*" is satisfactorily low.

In the field of **safe operation** the „safety systems and components" indicator remained yellow, because the included „failures of engineered safety systems" low level indicator remained yellow. The two failures in 2013 were followed by only one in 2014. This is a numerical decrease that fits into the alternation range of the last years. The other indicator of the field, „risk", showed no problem. The „environmental release" indicator,

which is built up of „gaseous discharge", „liquid radioactive discharge" and „solid radioactive waste", has been acceptable for years.

At **safety culture** the performance improved, because „number of violations" decreased further in comparison with the previous years, and the low number of „events due to human failure" has been typical for years. The other indicators of the field, „striving after correction, self-assessment", „experience feedback", „radiation protection effectiveness" and „effectiveness of industrial safety program" is acceptable.

Events
3 events occurred at the Training Reactor in 2014: one tank (reactor vessel) water level measurement failure, one false protection signal, one automatic control rod drive failure. No event occurred in 2014 related to OLC violation, OLC taking effect, radiation safety and human failure, recurrence or due to natural phenomenon. Reactor trip occurred twice.

Licensing
The HAEA released 2 decisions related to the BUTE TR (1 resolution, 1 procedural decision).

In the resolution the HAEA shifted the deadline of the nuclear measurement chain reconstruction ordered after the Periodic Safety Review to 31.08.2015. The reason of delay in reconstruction by the prescribed deadline was the extent of reconstruction that was expanded significantly during concept planning and the public procurement process necessary due to the expected cost needed more time.
The licensee verified in its analysis that the safe operation can be maintained until conducting the reconstruction, because the built-in reactivity of the Training Reactor is low (below 80 cent present), and the reactor physics transients are slow. So in case of a measurement chain failure, since the other chain operates in the same power range, the automatic reactor trip can be performed. In its application on the basis of the progress status of the public procurement process the licensee determined the final date of nuclear measurement chain reconstruction as 31.08.2015. The HAEA approved the deadline shift based on the licensee's analysis on the low built-in reactivity and considering single failure criterion.

In the procedural decision the HAEA cancelled the process due to lack of authority, which the licensee started in order to have the organisational and operational rules approved after modification.

The licensee of the facility announced the fulfilment of one PSR task. It had to compile a concept plan on interim storage and/or final disposal of spent fuel. The plan submitted with a small delay was accepted by the HAEA.
Other two fulfilments referred to the preliminary notification of the regulator on technological measurement chain reconstruction activities.

Inspection

At the TR the HAEA conducted inspections seven times and prepared eight records during them. The records were related to the cyclic maintenance in two cases, management of modification processes in one case, preparation and performing of technological measurement chain refurbishment in three cases, „violation" safety performance low level indicator in one case and an event related to safety logic and control rod drive mechanism in one case.

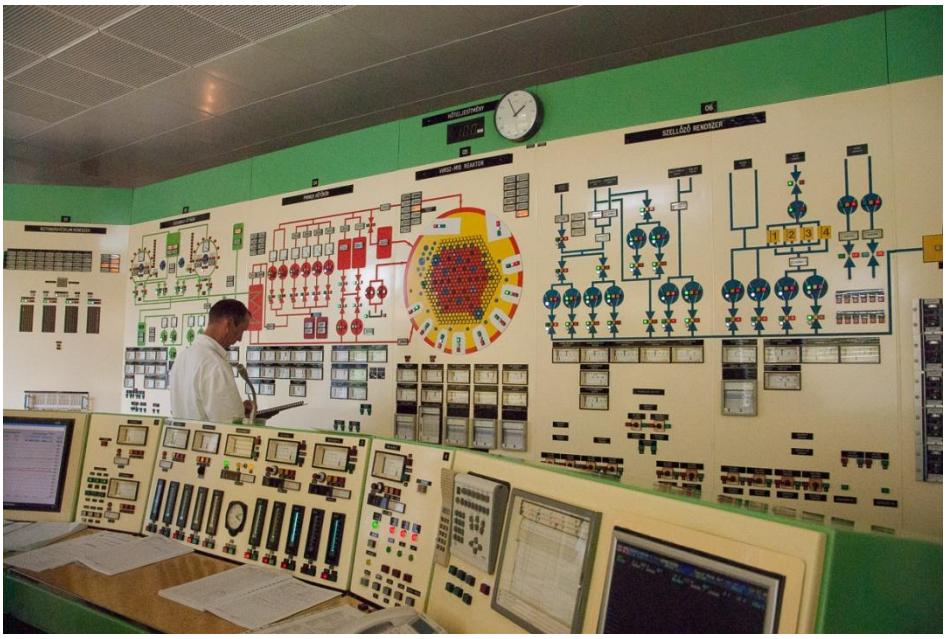
The inspected fields operated in accordance with the legislation, and there was no need for regulatory intervention.

In summary it can be stated on the basis of qualification of the indicators that the field of „Smooth Operation" has been stable good for years, the fields of „Safe Operation" and „Safety Culture" has kept their almost immaculate standard.

2.4 Budapest Research Reactor

The HAEA states on the basis of safety performance assessment of BRR in 2014 that the facility **operated according to the legal prescriptions**. The operation of the facility meant **no health risk increase either to BRR employees or the public**. The value of occupational dose exposure is comparable with the values of the previous years; the radioactive discharge was favourably low and stayed significantly below the authorized limits. The operation of the reactor was performed in accordance with the prescriptions and followed the Operational Limits and Conditions (OLC).

The safety performance reflected by the safety performance indicator system has improved a little in all the three fields due to one or two improving low level indicators on each of the fields in comparison with the previous years, thus it approached to the usually unexceptional values.



Picture 2.4-1: Control room of Budapest Research Reactor (Source: Helene Vacelet)

It must be emphasized in case of the main assessment field of „Smooth Operation" that all the low level indicators were green in 2012, thus received acceptable qualification, but in 2013 the values declined even in two fields, out of which the „Radiation Controlling System" of improved in 2014.
In the field of operation indicators, the „Unplanned shutdowns and power changes due to internal causes" kept the high value (9) of the last year. Due to that the low level indicator, and through it the indicator, has a yellow qualification against the suitable performance of all the other low level indicators. The low level indicator practically would receive an acceptable qualification, if there were not six cases of power reductions in due to failures of the Cold Neutron Source meant in order to protect the CNS. Improvement can be expected only after CNS compressor replacement, what is basically out of authority of the BRR staff.

The „Condition of systems and components" indicator changed to green, because the condition of „*cooling and venting systems*", „*safety systems*", „*nuclear chains*" and „*primary and secondary technological measurement chains*" was good. The number of failures at „radiation monitoring system" significantly decreased; therefore the low level indicator improved and became green again.

In case of other indicators of the field it can be stated that the „*condition of safety barriers*" is acceptable, and „*number of events*" is small.

In the field of safe operation the „Releases" indicator deserves attention, because it degraded from green to yellow qualification. Its reason is that the „solid radioactive waste" slightly exceeded the limit after 5 years; therefore the low level indicator degraded to yellow. The other indicators: „safety systems and components", „risk" is green.

In the field of safety culture all indicators received green qualification. Special attention is deserved by „Violation", that improved from red in 2013 (4 cases of prescription violation) to green in 2014 (0 case). The regulatory opinion is that the new prescription register can significantly support to keep the value of the low level indicator low. The authority examined the use of the register during an on-site inspection.

Events

Two reportable events occurred in 2014 in BRR. In one case one of the main coolant pumps failed, therefore they had to change to the reserve one. In the other case, the improper isolation of the main coolant valves was detected during preparation for the above mentioned main coolant pump repair.
No event occurred in 2014 in relation to OLC violation, radiation safety, human failure, recurrence or due to natural phenomenon. The mentioned event involving switching to the reserve pump was with OLC taking effect.

Licensing

The number of regulatory decisions concerning the BRR decreased further in 2014. The HAEA released two decisions for BRR in 2014. In one case the HAEA licensed the modification of the gaseous radioactive discharge monitoring system of the facility. In the other case, a temporary modification of the Operational Limits and Conditions was necessary to perform a core parameter checking before core unloading for repair of the failed main coolant pump and a sealing replacement.

Inspections

The HAEA performed on-site 6 inspections regarding the nuclear safety of the facility. Three inspections referred to the failed main coolant pump and the failure identification of the main closing valve sealing during its repair. Two inspections addressed the

maintenance of the summer main outage and the following restart preparation. One inspection was related to the design of the 34th campaign.
No safety jeopardizing problem was identified during the inspections, and there was no need for any regulatory intervention.

In summary it can be stated on the basis of indicator qualification that the field of „smooth operation" has been stable for years, and there is only one yellow low level indicator. The „safe operation" has kept the almost immaculate performance of the last year. With the improvement, the immaculate performance in field of „safety culture" of the previous years was restored."

2.5 National Radioactive Waste Repository (NRWR, Bátaapáti)

Changes in regulatory oversight

Picture 2.5-1: Main hall of technological building
(Source: http://www.rhk.hu/images/sajto/nrht-felszin-technologiai-epulet-uzemcsarnok.jpg)

The Article 11 Paragraph (4) of Act CI in 2013 on modification of Act CLXI in 1997 on atomic energy, other energy related issues, in addition to armed security guard, nature protection, etc. modified the Article 17 Paragraph (2) Point 15 of Act on Atomic Energy. On the basis of this, the licensing and inspection of siting, construction, operation, modification and closure of radioactive waste repositories belongs to Hungarian Atomic Energy Authority, as the atomic energy oversight authority, instead of Government Office for Tolna County since June 30, 2014.

The Govt. Decree 155/2014 (VI.30.) on safety requirements and related regulatory activities of facilities providing interim storage or final disposal of radioactive waste came into force on June 30, 2014 as the result of a working group led by the HAEA meant to carry out the transfer of the oversight and create the new legislation.

During codification of the new governmental decree, the working group took into account the Decree 47/2003. (VIII.08) of the Minister of Health, Social and Family Affairs

on certain issues of interim storage and final disposal of radioactive wastes, and on certain radio hygiene issues of naturally existing radioactive materials concentrating during industrial activity, in addition to the requirements (so-called reference level) of the Western European Nuclear Regulators Association Working Group on Waste and Decommissioning (WENRA WGWD) developed for radioactive waste storage facilities.

After taking effect of Govt. Decree 155/2014 (VI.30), the HAEA started its regulatory activity. In its framework, the HAEA collected and systematized the available documents (licences, decrees, analyses, etc.) referring to waste storage facilities. It performed the necessary actions to take over the regulatory processes under way and in order to assess and enhance the present safety of waste repositories, verify the compliance of the local processes with the related legislative prescriptions. In order to do this, the HAEA made closer the relationship with the licensees of the repositories and cross-checked with the PURAM Ltd. the expectations of the authority, implemented the practice of weekly reports, within the framework of which the licensee regularly gives account of on-going activities and events related to the sites for the HAEA.

The HAEA states on the basis of safety performance assessment of 2014 second half-year that the facility operated according to the legislative prescriptions. The operation of the facility meant no additional health risk increase neither to NRWR employees or public. The occupational dose exposure is comparable with the values of the previous years; the value of radioactive discharge was low and remained significantly under the authorized limits. The operation of the facility was in compliance with the prescriptions.

The safety performance indicator system supporting the assessment of radioactive waste disposal facilities is still under construction. There are data already available for some indicators. After having finalized the safety performance indicator system, there will be an opportunity to follow up changes, qualify deviations, assessing trends and to early recognize the declining tendencies.

Events

No reportable event, due to natural or other phenomenon related to radiation safety occurred in 2014 in the NRWR.

Licensing

The HAEA categorized in one case a newly planned modification (into category 3) in relation to the NRWR based on the submitted documents, therefore no new licensing process under ruling of Govt. decree 155/2014 (VI.30) began.

Inspection

The HAEA conducted in 2014's second-half nine ad-hoc inspections documented in records at NRWR in Bátaapáti

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

The safety performance indicator system is under construction. Therefore and due to the progress of related data collection it is not possible yet to conduct the comprehensive safety performance assessment.

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

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

Regarding the transition of regulatory oversight of the facility to HAEA see Chapter 2.5 'Changes in regulatory oversight'.

Events

No reportable event, due to natural or other phenomenon related to radiation safety occurred in 2014 in the RWTDF.

Licensing

The HAEA categorized in two cases newly planned modifications (both of them into category 3) in relation to the RWTDF based on the submitted documents, therefore no new licensing process under rule of Govt. 155/2014 (VI.30) began.

Inspection

The HAEA conducted in 2014's second-half six ad-hoc inspections documented in records at RWTDF in Püspökszilágy.

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

The safety performance indicator system is under construction. Therefore and due to the progress of related data collection it is not possible yet to conduct the comprehensive safety performance assessment.

I. Appendix: Regulatory assessment methodology

The safety has a priority over all aspects at operation of nuclear facilities. The Hungarian Atomic Energy Authority (HAEA) annually evaluates the safety performance of nuclear facilities belonging to its scope of authority.

The safety performance of operation can be justified with an assessment taking into account many aspects, using engineering and safety evaluation tools in addition to indicators expressed with quantitative markers.

The evaluation of safety performance is carried out on base of assessment and analysis of regulatory inspection results, operational data, and inspection of events during operation. In order to achieve this, the HAEA:

- Collects operational data, makes trends of them,
- Reviews and assesses the events occurred in that year,
- Performs safety evaluation of events,
- Performs probabilistic safety assessment based evaluation events, especially examines the events originated by human failure and recurrent events,
- Comprehensively assesses the safety performance with the help of safety performance indicator system.

The HAEA took into account the degree of potentially dangerous nature of the facilities under its control during their safety performance assessment.

The HAEA determines the evaluation criteria of safety indicators in a way, they take into account the achieved safety performance level of the nuclear facility and the national and international experiences related to safe use of atomic energy, in addition to helping the licensees to raise the level of safety performance.

The operational safety assessment is carried out with attributes considering many aspects and quantitatively expressible, so called safety performance indicators. Beside the indicators, the authority uses engineering, safety evaluation, because the safety performance of the facility can be verified only as result of a comprehensive assessment. In many cases just the comparison with the results, performance indicators of the previous years provides results.

I.1. Safety Performance Indicator System (SPIS)

On behalf of HAEA NSD, the VEIKI had worked out the Safety Performance Indicator System following the recommendations of the International Atomic Energy Agency, on base of IAEA TECDOC-1141. The system has been implemented in 2001 for the most significant nuclear facility, MVM Paks Nuclear Power Plant (Paks NPP).

On base of experiences gained from application for Paks NPP, the Safety Performance Indicator Systems of the remaining facilities under HAEA control,

- Interim Spent Fuel Storage Facility (ISFSF),
- Training Reactor of Budapest University of Technology and Economics, Institute for Nuclear Technology,
- Budapest Research Reactor (BRR),

have been implemented, and the HAEA have been using these systems since 2005. Therefore the assessment is supported by the results of the safety performance indicator system in case of all facilities.

With the proper indicator selection it is possible to monitor continuously the nuclear facility, evaluate changes, and identify early the worsening tendencies. In case of early deficiency detection, the authority can initiate proper measures to avoid the decline of safety under acceptable level.

The HAEA determines the assessment criterion of the realized safe operation taking into account the safety level achieved in the last years, in addition to the national and international experiences. The HAEA does so in order to help the licensee to recognize the problems early.

Data for safety performance indicator system is provided by the following sources:

- Periodic reports (quarterly report, annual report, campaign report, main outage report),
- Event reports: reports on safety related events and their inspection,
- Results of authority reports,
- Information gained during authority's licensing activity.

The HAEA continuously monitors the NPP's activity. This activity is realized by different types of authority licensing processes, inspections and the reviews, assessments of periodic and event reports of the operator.

The collection, calculation and handling of data necessary for SPIS operation is according to written procedure, on base of pre-defined task-responsibility allocation. The task-responsibility allocation extends to collection of data for indicators, making trends, producing indicators and the compilation of summary assessment.

I.2. SPIS structure

The SPIS's four levels build up a hierarchical system (Figure 1.). There are the three main evaluation are on the top of the system. Every area is made of part areas of safety indicators. The safety indicators are made of low level safety indicators provided with

measurable and predefined evaluation criterion. The assessment of safety indicators and part areas is carried out on base of the results of low level safety indicators.

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

The HAEA allocates the indicators onto three assessment main area at each of the facilities:

PAKS NUCLEAR POWER PLANT
- smooth operation,
- safe operation,
- safety culture;

ISFSF
- smooth operation,
- safe operation,
- safety culture;

BME NTI TR
- smooth operation,
- safe operation,
- safety culture;

BKR
- smooth operation,
- safe operation,
- safety culture.

RWTDF
- smooth operation,
- safe operation,
- safety culture.

NRWR
- smooth operation,
- safe operation,
- safety culture.

Depending on the characteristics of each facility, there are different safety low level indicators necessary for the safety assessment. The following table contains the number of indicators and low level indicators:

Number of	Paks NPP	ISFSF	TR	BRR	NRWR	RWTDF
Main assessment areas	3	3	3	3	3	3
Assessment part areas	9	-	-	-	-	-
Indicators	22	10	12	12	10	10
Low level indicators	58	19	24	30	19	19

Table I.1-1: Low level indicators and indicators in the facilities

The regulator assesses the low level indicators in accordance with individually defined criterion and provides colour code for them according to the followings:

„Green": The green margin of the low level indicator extends to the limit considered suitable by the authority. The authority regards the values of the green margin as suitable, and does not regard any further action or special attention as necessary. In case of declining trend or value close to the yellow margin, the licensee, recognizing the problem, can do preventing actions.

„Yellow": The borders of warning, yellow margin warn of deviation from the desired values within the margin allowed by the authority. For the low level indicators in the yellow margin, special attention must be paid, and the licensee must work out an action plan in order to eliminate the unfavourable qualification. The authority calls upon the licensee in a letter to conduct the action plan, and it ascertain the fulfilment of the plan by the review of periodic reports and inspections.

„Red": The lower border of not suitable, red margin of low level safety performance indicator is a numeric value approved by the authority or, in absence of regulated value, individually determined criteria. The licensee must prepare an action plan that is complemented, in need, and ordered by the authority with tasks found to be necessary. The licensee must report on the fulfilment of the tasks in the action plan in the regular reports, and the authority reviews the progress during inspections.

„White": The status of the low level safety performance indicator is not known. There are several possible reasons. One of them is a change in the licensee's organization or informatics system that temporarily hinders or prevents the data collection necessary for the low level indicator. Then it is necessary to review the reporting system in order to discover, if it is possible to get information from other sources, and to reconcile with the licensee, when and how it will restart the data support.

The safety performance indicators envelope low level safety performance indicators, which are connected but by each other non-replaceable, therefore the colour based

assessment of the indicator is made on the base of the colour of worst low level indicator within it.

The particular area must be assessed not only on base of indicators' colour but other aspects, in order to take into account not only the quantitative low level safety performance indicators but the information from other sources.

The HAEA has a special role during SPIS operation, because it does not directly affect the evolution of the values.

The information provided by the low level safety performance indicators help the HAEA to identify the problematical areas and necessary regulatory steps. The SPIS results show, which area needs to develop the capabilities on, what actions are necessary, in the area of human resource, systems, structures and components in order to raise the future level of performance.

The HAEA informs the NPP management on the results of the assessment, and calls its attention to the issues, that needs further inspection, action, or in case of need, the HAEA conducts inspection, initiates actions.

The change of safety performance level is represented by a pie chart (Figure I.12.). The chart shows the numeric value of low level safety performance indicators on a relative scale, where the values of low level indicators appear in order of growing measure of percentage of the criterion. The three sectors represent the three main assessment areas. The three, coloured assessment margins are represented by the green circle, the yellow and red rings. The area under the curve defined by the values can be regarded as the general print of the safety performance in the assessed time interval. It provides an overlook on the areas found by SPIS to be problematical and on the chronological change of safety performance. It is easy to observe the chronological change of the particular areas with the enveloping curve of the low level safety performance indicator values.

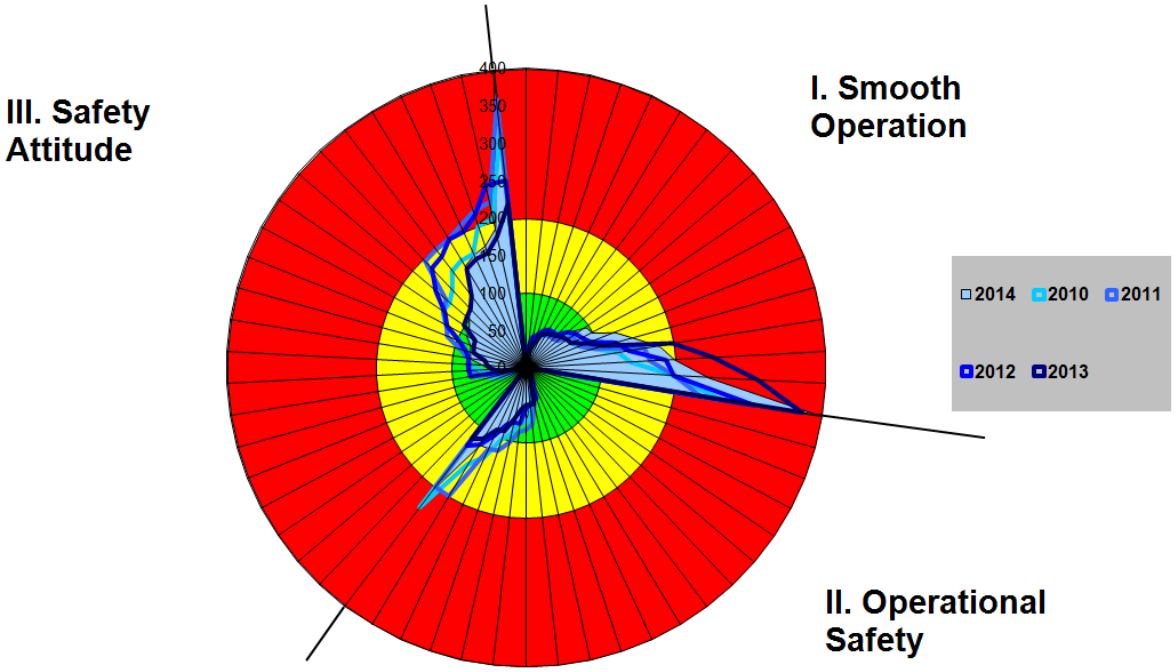


Figure I.1-2: SPIS pie chart

I.3. Safety assessment of events

The HAEA implemented an auxiliary method for the safety assessment of events: The assessment method categorizes the events on base of their safety effect in a way, when the numeric values are given to each deficiency according to its safety significance. The summary of the numeric values given to the attributes and determined during event assessment characterizes the event. There is a relative scale gained with its help, that scale shows the safety significance of events compared to each other. The numeric value of the event may not be used as an absolute indicator or marker, but the event having gained higher score has more deviation affecting safety. The assessment system gives special attention to the events showing different variants of human failure. The results of the assessment help to justify the safety significance of events and to establish the regulatory inspection strategy intending to eliminate the direct cause of events.

The method is based on the data gained from inspection. The factors determining the assessment are the following:

- Initiating event,
- Protective action,
- TechSpec taking effect or TechSpec violation,
- Action of personnel,
- Level of core melt risk during event
- Cause of event,
- Other factors leading to the event,
- Safety class of affected systems, components,
- Dose exposure of personnel,

- Level of radioactive discharge/contamination.

After closure of event assessment, there are numerical values given to each attributes listed above, and their sum characterizes the event.

II. Appendix: Nuclear facilities in Hungary

II.1. Paks Nuclear Power Plant

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

Unit	Power	First criticality	Type	Location	homepage
Unit1 PAE1	500 MW_e	1983	WWER-440/213	Paks	www.atomeromu.hu
Unit2 PAE2	500 MW_e	1984	WWER-440/213		
Unit3 PAE3	500 MW_e	1986	WWER-440/213		
Unit4 PAE4	500 MW_e	1987	WWER-440/213		

II.2. Interim Spent Fuel Storage Facility (ISFSF)

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

Type	Construction	Location	homepage
dry, modular, vault type	1997-	Paks	http://www.rhk.hu/letesitmenyeink/kkat/

II.3. Training Reactor of Budapest University of Technology and Economics

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

Type	Power	Start	Location	homepage
pool	100 kW_{th}	1971	Budapest, District 11, Műegyetem rkp.	www.reak.bme.hu

II.4. Budapest Research Reactor

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

Type	Power	First criticality	Location	homepage
tank	10 MW_{th}	1959	Budapest, Distr. 12.	www.aeki.kfki.hu

II.5. National Radioactive Waste Repository (NRWR)

National Radioactive Waste Repository (Source: http://www.rhk.hu/sajto/fototar/)

Type	Capacity	Start	Location	website
under surface repository	21500 m^3	2012	H-7164 Bátaapáti Mórágyi-valley 4.	http://www.rhk.hu/letesitmenyeink/nrht/

II.6. Radioactive Waste Treatment and Disposal Facility (RWTDF)

Radioactive Waste Treatment and Disposal Facility (Source: http://www.rhk.hu/sajto/fototar/)

Type	Capacity	Start	Location	website
near surface	5040 m^3	1976	H-2166 Püspökszilágy 043/20 tln.	http://www.rhk.hu/letesitmenyeink/rhft/