



Safety
performance
2022



Paks NPP

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FOREWORD

The Safety Performance Indicators System is based on indicators, which describe safety operation of the plant by calculated values. The safety standard of operation is at the top level of the Safety Indicators System established in 2000-2001 and introduced in 2002 on the basis of recommendation issued by International Atomic Energy Agency, and this indicator relies on three attributes featuring a power plant safely operated. The three main attributes are as follows: normal operation, operational safety and commitment of the staff towards safety. Since it is not possible to directly measure these attributes, the system had to be extended to the level of easily calculable or directly measurable indicators. Consequently, the Safety Performance Indicators System consists of three additional lower levels. These levels are as follows: the level of general indicators, the level of group indicators and the level of specific (featuring) indicators. The lowest level of the whole system consisted of 83 specific indicators in 2022. The physical value of lower level indicators of the system is compared to the target values assigned to the indicator (strategic target, annual target, measure-required value). As a result of this comparison, score value of the indicator is available, on the basis of which, it is possible to calculate the score value of indicators at the higher level, using the weighing factor assigned to the indicator. Taking the score value into account, all indicators can be classified into one of the four quality categories. The four categories marked also by colours are as follows: excellent range (green), operational range (white), warning range (yellow), measure required range (red).

Quality ranges of indicators		
100 score	Excellent range	strategic goal [SC]
80 score		
50 score	Operational range	annual goal [ÉC]
20 score	Warning range	measure required value [NE]
0 score		
	Measure required range	

For indicators which are subject to regulatory limit, the measure required value was identified in a way to ensure that it is more rigorous than the limit specified for the given indicator. Thus, the measure required

(red) value of the indicators does not mean that the power plant exceeds the relevant safety limit. With this arrangement, the power plant intends to provide for a significant margin of safety. Of course, for the red coloured indicators, the power plant will formulate the corrective actions that are required for improving the indicator.

The three figures shown on pages 30-32 determine annual values of indicators forming the three attributes of the Safety Performance Indicators System for the year of 2022. At the three top levels, the indicators have only a score value, while the box of indicators at the lower level contains also the physical value in the left side cell.

In case of some indicators, the values are broken down to reactor unit level. In these cases, value of the indicator is formed by the worst value (with the lowest score).

The System of Safety Indicators (BMR) is a web-based program. Using this program, the employees of Paks NPP can follow the trend of safety indicators via the Intranet.

WANO PERFORMANCE INDICATORS



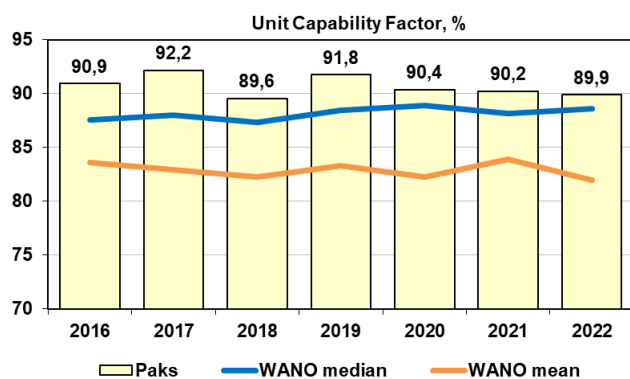
Established after the Chernobyl nuclear accident World Association of Nuclear Operators (WANO) started the Plant Performance Indicator Programme at April 1990.

The majority of the WANO indicators are not deemed to be reactor specific; in relation to these indicators, the data of Paks Nuclear Power Plant is compared with all units providing valid WANO data. Some indicators, however, are closely linked to reactor type, thus comparison in relation to these indicators is performed with the more limited group of units operating with the pressurised water reactor (PWR). WANO produces the indicators for various time intervals (1 year, 18 months, 2 years, and 3 years); comparison in this publication is made on the basis of indicators calculated for 1 year in relation to the given year.

The graphs from the Paks side demonstrating the data for a 7-year period give the mean value for four units, from the WANO side both the mean and the median value are indicated. In fact, the comparison with the median value means that we examine whether an „average” Paks unit belongs to the better or the weaker half of the WANO units.

W.1 Unit Capability Factor

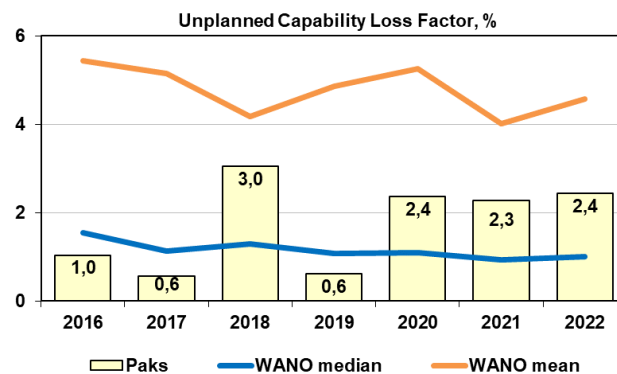
This indicator compares the theoretically possible amount of electricity generation to the power generation reduced by planned and unplanned power losses. The Unit Capability Factor (UCF) provides a general characterisation of operation and maintenance level of the plant.



Between 2016 and 2022 the Unit Capability Factor of Paks NPP was above the WANO median.

W.2 Unplanned Capability Loss Factor

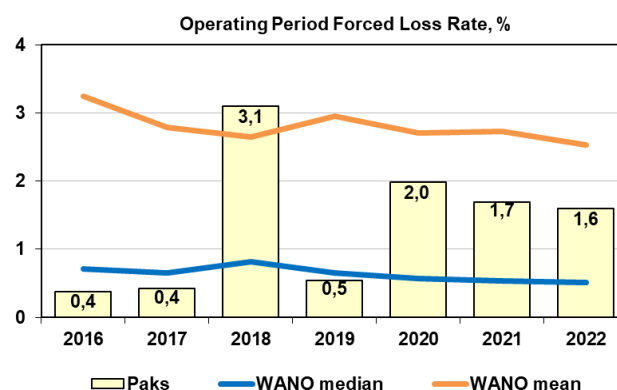
The Unplanned Capability Loss Factor (UCLF) is the ratio of unplanned power losses to the amount of electricity which could have been generated during the given time period.



In 2018 this indicator was affected by three events that led to the significant loss of production, while in 2020 the increase was caused by outages due to generator failures. In 2021, the value of the indicator became higher due to the repair of hermetic penetration of the level measurements of the bubble condenser trays at Unit 2 and due to the repair of the faulty primary loop thermometers at Unit 1. In 2022 significant share of the generation loss was caused again by generator failures.

W.3 Forced Loss Rate

The indicator represents the ratio of unplanned loss of production during the operational time of the units and the theoretically possible amount of electricity generation reduced by the loss of production resulting from planned shutdowns and their possible unplanned delays during the same period.



In 2018, three major cases of loss of production significantly affected the indicator value, while in 2020 the increase was caused by outages due to generator failures. In 2021, the value of the indicator became higher due to the repair of hermetic penetration of the level measurements of the bubble condenser trays at Unit 2 and due to the repair of the faulty primary loop thermometers at Unit 1. In 2022 significant share of the generation loss was caused again by generator failures.

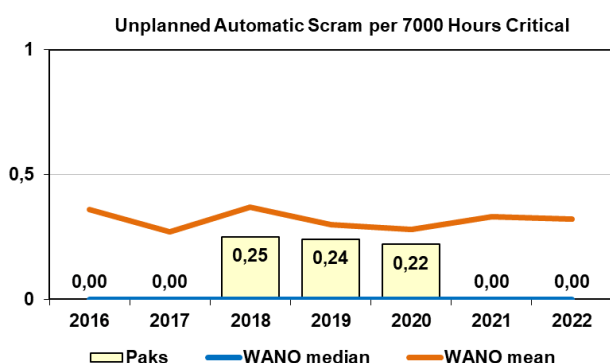
W.4 Grid-Related Loss Factor

This indicator was first introduced also in 2008, expressing the ratio of loss of production resulting from network causes to the theoretically possible amount of electricity generation in the given period. In 2022, no such loss of production occurred at Paks, while the WANO mean is 0.07%.

W.5 Unplanned Automatic Scrams

During reactor scram actuation the reactor is promptly shut down by dropping all control rods into the reactor core.

This WANO indicator shows the number of automatic reactor protection actuations during a period of 7000 critical hours. This indicator provides an indication of success in improving plant safety by reducing the number of undesirable and unplanned thermal-hydraulic and reactivity transients requiring reactor scrams.



In 2018, there occurred one automatic scram while handling transient processes caused by the impact of protection actuation generated from the external network. In 2019, the differential protection actuation at one of the in-house needs transformers on Unit 4 led to a total auxiliary black-out and shutdown of the reactor. In 2020, temperature measurement of the lubricant in a turbine bearing with short-circuit fault

triggered a transient, which eventually led to the trip of the reactor in unit 4.

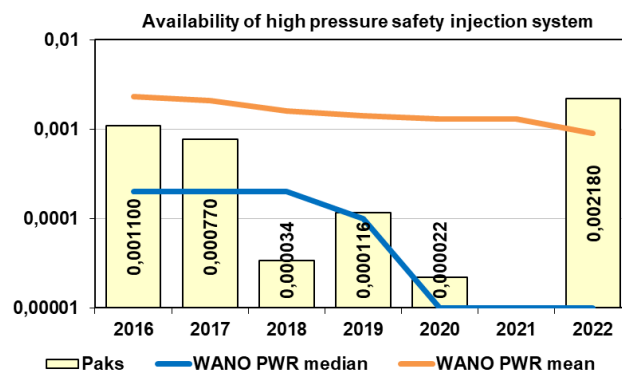
W.6 Unplanned Total Scrams

This indicator was first introduced by WANO in 2013 and besides unplanned automatic scrams it takes into consideration unplanned manual reactor scrams as well. There have been no manual reactor scram actuations in reactor critical states at Paks during the past seven years, thus the indicator value is the same as the W5 indicator value.

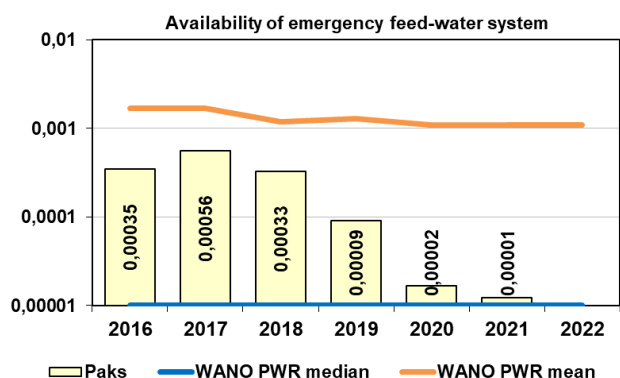
W.7 Safety Systems availability

This indicator is defined as the ratio of equipment unavailability / planned period of availability of the system / number of trains (that is, actually it indicates the degree of unavailability). The WANO forms indicators for the systems of TH (high pressure Safety Injection System), RR (emergency feed-water system) and QD (emergency electrical system).

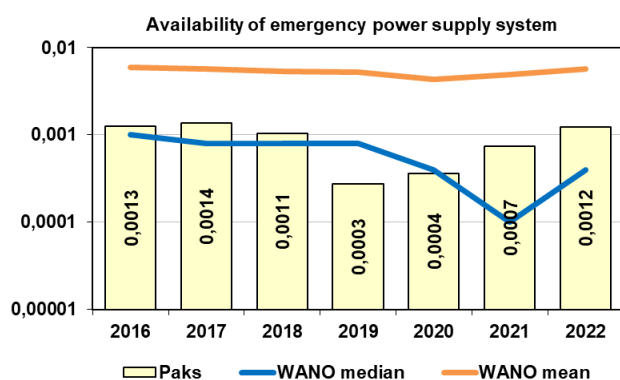
Note that in the presentation of the availability indicator, actually, the non-availability value is presented in the graph below in accordance with the definition.



In 2016-2021 the availability of the system was under the mean calculated for PWR Units. The longer unavailability in 2016 was due to the failure of one of the circuit breakers of the TH pump on Unit 3. In 2017 the higher value was caused by the summed up value of several events leading to the short-time unavailability. In 2018-2021 the indicator value was more favourable compared to that of the previous years, due to fewer cases of failures. In 2022 one HPIS pump had to be declared inoperable due to the repeated failure of the intermediate circuit cooling pump.



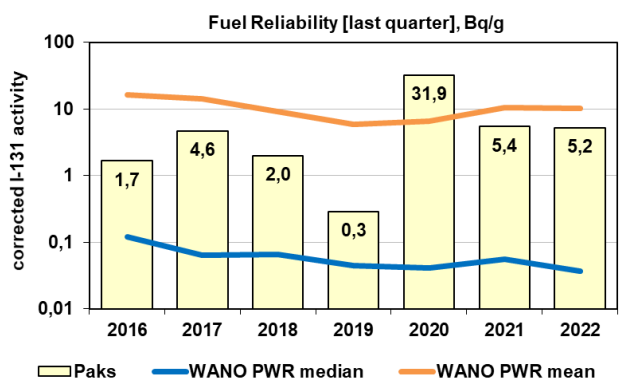
In 2016-2021 the availability of the system was above the median calculated for PWR Units. In 2021, the value of the indicator is very favorable. In 2022, however, there was no failure of this system at all.



In 2016-2018 the availability of the system was around the median calculated for WANO Units. Only a few diesel failures occurred in 2019-2020. In 2021-2022 the value of the indicator was deteriorated.

W.8 Fuel Reliability

This index is defined as the steady-state iodine (I-131 and I-134) activity of the primary coolant, corrected for the tramp uranium contribution and power level, and normalised to a constant blow-down (water purification) rate, i.e. it reflects the integrity of the fuel. The data pertains to the last quarter of the year.

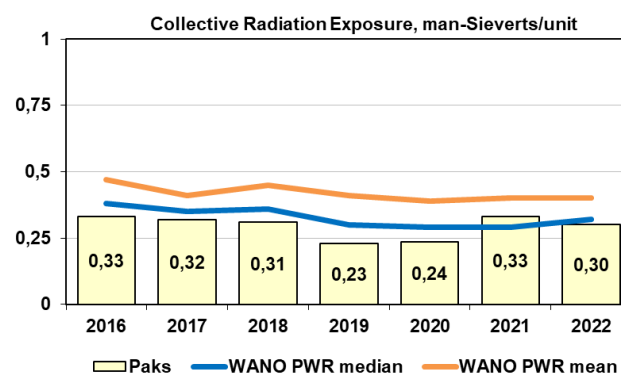


It can be stated based on the WANO PWR median of the fuel reliability indicator that nearly half of the PWR units had been operating with undamaged fuel during the years concerned. The average value achieved at Paks indicates that probably there was leaking fuel in the core of one unit.

It is important to note that the rate of leaking had never reached the value, which would have required the shutting-down of the unit. In 2017 and 2018 on Unit 4 measurements indicated the possibility of micro-damage on a fuel assembly. In 2019, the indicator has changed more favorably, however, in 2020-2022, a leaking fuel assembly in unit 4 was detected again by measurements.

W.9 Collective Radiation Exposure

This indicator is the external exposure derived from whole body exposure and the internal exposure of all employees of the plant and the external contractors, as well as of the visitors, referred to one unit.

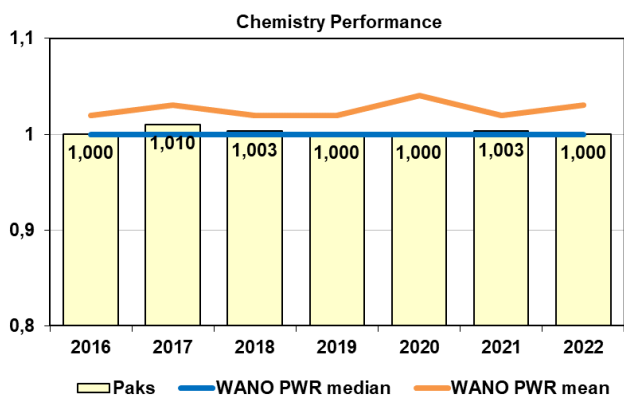


Since year 2013 the indicator's reduction has continued permanently, thus, between 2016 and 2020 the indicator fell below the WANO PWR median. In 2021 the collective dose of the Unit 2 outage significantly exceeded the planned value, so the value of the indicator became higher. In 2022, the indicator was again kept below the WANO PWR mean value.

W.10 Chemistry Performance

This indicator monitors the concentration of selected impurities in steam generator blow-down and in the feed-water. Its value is 1, when the concentration of impurities does not exceed the average value of WANO defined limits.

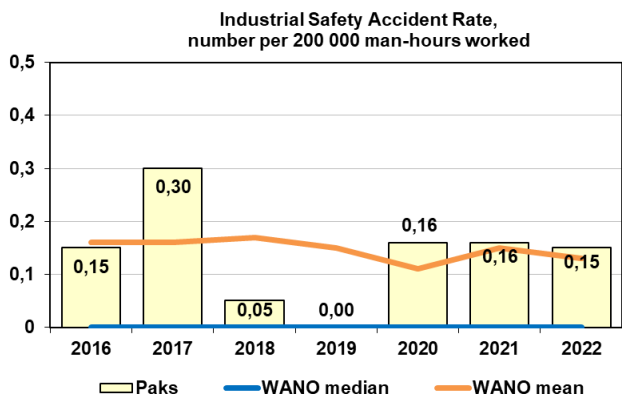
Safety Indicators of Paks Nuclear Power Plant in 2022



In a few years the value of the WANO chemistry index has exceeded the ideal value of 1, because the concentration of disperse iron in the feedwater was higher than the relevant WANO limit. In the other years, there were no cases of impurities concentrations exceeding the limit value.

W.11 Industrial Safety Accident Rate

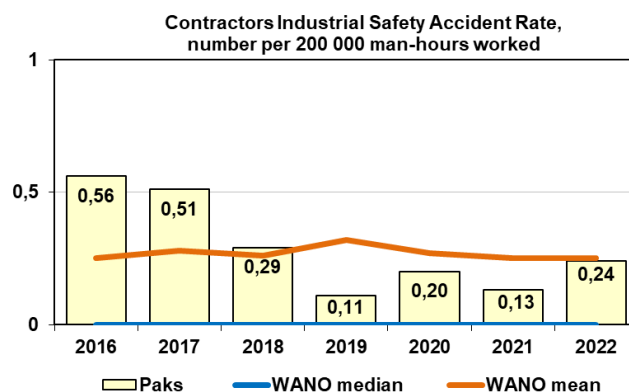
This indicator is defined as the number of accidents for all utility personnel assigned to the station that result in one or more days away from work or one or more days of restricted work, or fatalities, per 200,000 man-hours worked. This is a clear indication for efficiency of the plant personnel work safety.



The value of the WANO median is continuously low, moreover it decreased to zero in 2013. In 2017 the indicator value at Paks units also exceeded the WANO mean (0,3 value means 6 industrial accidents in 2017). In 2018 there occurred only 1 industrial accident, while in 2019 no one. Three work accidents occurred in 2020-2022.

W.12 Contractors Industrial Safety Accident Rate

WANO introduced the industrial accident indicator of contractors working in the area of the power plant in 2008. It is generated similarly to the W.11 indicator.



Before 2016, the indicator was significantly higher than 0,5. It was successfully reduced to around 0,5 in 2016. The value of the indicator has further improved in 2018, and in 2019-2022 it left below the WANO mean.

The personnel of Paks Nuclear Power Plant can continuously follow the evolution of WANO indicators on the Paks NPP Rapid Information Monitor (PATRIK).

WANO patrik

A paksi blokkok üzemeltetésének értékelése a WANO Index alapján

A WANO Index egy olyan 0-100 pont közötti értékű komplex mutató, amely 10 WANO teljesítmény mutató súlyfaktorral figyelembe vett pontértéke alapján kerül kiszámításra. A számítás pontos módjáról a társasági WANO honlapon lehet tájékozódni.
A javuló teljesítményt az index növekvő értéke jelenti.
A blokkok teljesítményének minősítése az index értékek negyedekbe történő csoportosítása alapján történik.

	2022/II	2022/III	2022/III	2022/IV
1. blokk	93,1	93,5	90,5	90,6
2. blokk	92,4	92,3	95,2	95,2
3. blokk	99,9	99,9	99,9	100
4. blokk	98,2	95,8	95,8	92,2

A paksi blokkok helye a világ rangsorában 2022/IV - 398 blokk

1. blokk	2. blokk	3. blokk	4. blokk
191.	154.	1.	182.

A színek jelentése:
Leggyengébb negyed Harmadik negyed Második negyed Legjobb negyed

WANO patrik

Kulcsfontosságú WANO-mutatók: munkahelyi balesetek száma 200000 ledolgozott munkaórára

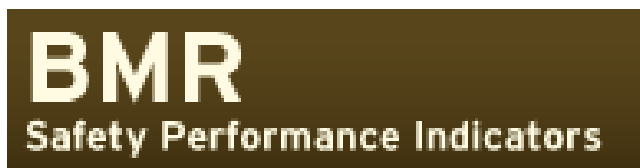
JAVULÁS IRÁNYA

Paksi Atomerőmű egyéni cél: 0,5
 Nemzetközi nukleáris iparági cél: ~0,15

2016. előtt: csak PA Zrt. munkavállalók | 2016-tól: PA Zrt. munkavállalók és vállalkozók

WANO indicators on the PATRIK monitor

SAFETY PERFORMANCE INDICATORS



In the chart showing the indicator trends, the colour of the columns corresponds to the colour indicating the rating of the indicator in the given year. An exception from this is the grey colour used to indicate that the performance indicator had not been a part of BMR (Safety Indicator System) during the given year. The target values assigned to the indicators may change and may be basically more rigorous. Therefore, it may happen that an indicator representing an identical or better value will still be worse based on the colour codes. Five years are shown in the graphs in case of Unit-type indicators, and seven years in case of Plant-type indicators.

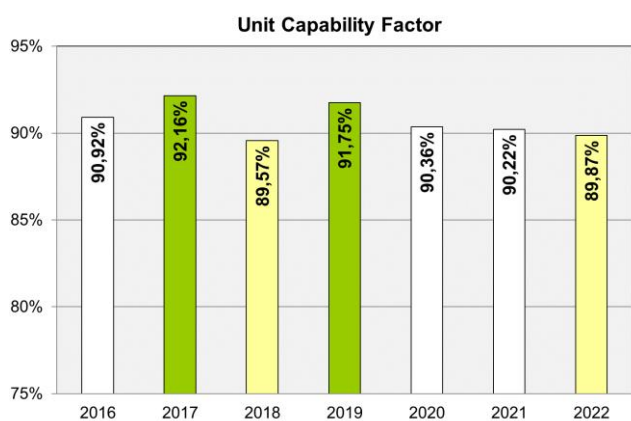
A. NORMAL OPERATION

A.I Operational Performance

A.I.1 Unplanned loss of production

A.I.1.1 Unit Capability Factor

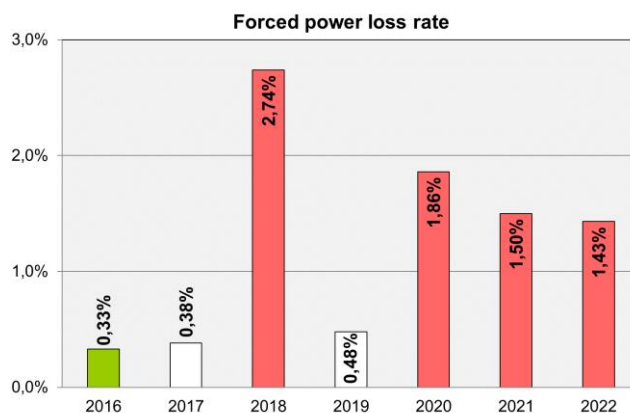
The indicator corresponds to the WANO availability indicator. The chart shows rating based on the System of Safety Indicators.



The annual value of the indicator in 2022 for each unit: 84.14%; 97%; 92.35%; 86.03%. The power plant average value is 89.87%. During the period of 2016-2017 the indicator value was continuously increasing due to a significant contribution of the introduction of a 15-month fuel campaign. In 2018 the availability of Unit 3 was far behind the targeted value. In 2019, a high value was reached again. Since 2020, the drop was caused mainly by generator failures.

A.I.1.2 Forced power loss rate

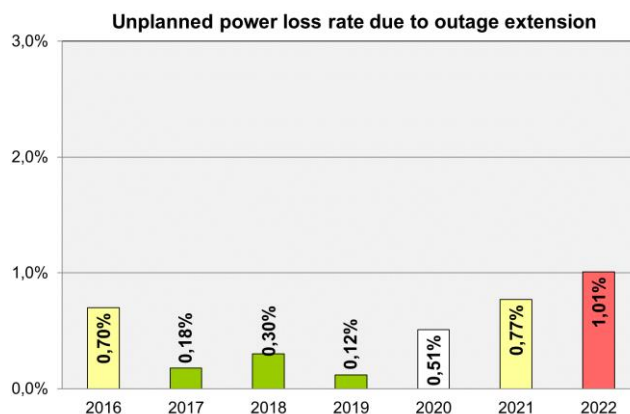
This indicator is the ratio of the forced losses of production and the energy that can be theoretically produced.



The value of the indicator in 2022 for each unit: 1.18%, 0.18%, 0.03%, 4.33%. The power plant average value is 1.43%. In 2018, there were such operational events at Units 2 and 3, and in 2020-2021 at Units 1 and 2, and in 2022 at Unit 4, which caused significant losses of production.

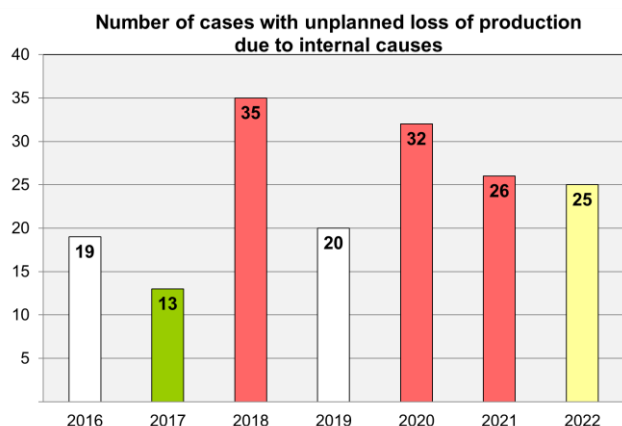
A.I.1.3 Unplanned power loss rate due to outage extension

This indicator is the ratio of the loss of production due to unplanned extension of the planned outages and the energy that can be theoretically produced.



The value of the indicator in 2022 for each unit: 0.52%, 0.66%, 0.37%, 2.47%. The power plant average value is 1.01%. In 2022 the outages on all affected units were completed behind schedule.

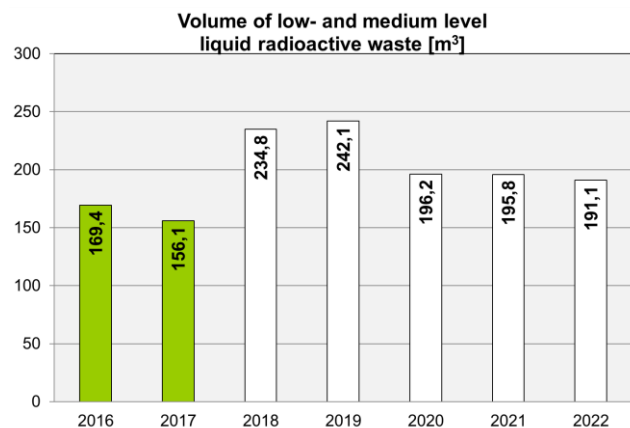
A.1.1.4 Number of cases with unplanned loss of production due to internal causes



The number of cases with unplanned loss of production in 2022 was 25; distribution among the units: 7; 5; 3; 10. Outages due to necessary brush replacements as a consequence of the fast wear and tear of carbon brushes in generators significantly contributed to the high value of the indicator in 2020-2022.

A.1.2 Radioactive waste

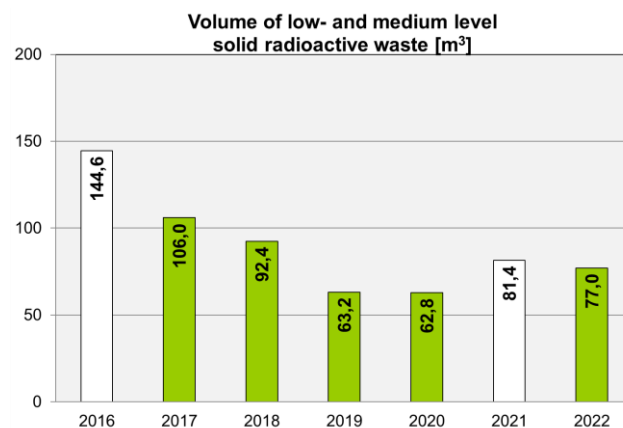
A.1.2.1 Volume of low- and medium level liquid radioactive waste



Before 2015 the volume of liquid waste was above 200 m³. Significantly smaller volume of such type of waste was generated between 2015 and 2017. Since 2018, the indicator value was again recorded at the level of average value characteristic for the years before 2015. The value of the indicator in 2020-2022 is considered to be average.

A.1.2.2 Volume of low- and medium level solid radioactive waste

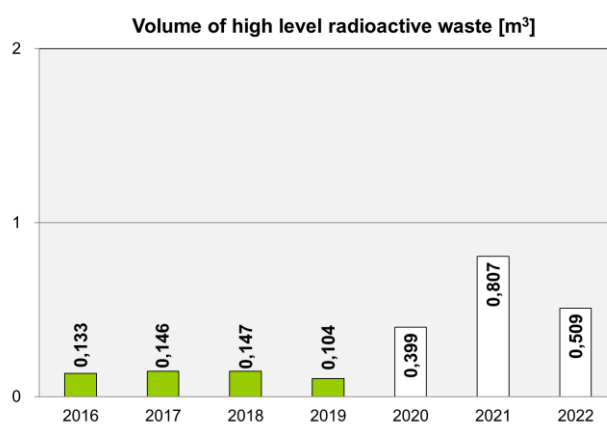
This figure indicates the amount of solidified wastes packed in drums (containers included), prepared for disposal in the past years.



Due to the introduction of the 15-month campaign, in 2017-2019 there were only three outages performed instead of the usual four per year, the impact of which can be noticed in this indicator. In spite of four major overhauls in 2020, the value of the indicator was successfully kept at a low level. In 2021 and 2022, however, more such waste was generated.

A.1.2.3 Volume of high level radioactive waste

This indicator represents, in unit volume, the quantity of high level solid radioactive waste stored in the interim store facilities of the plant.



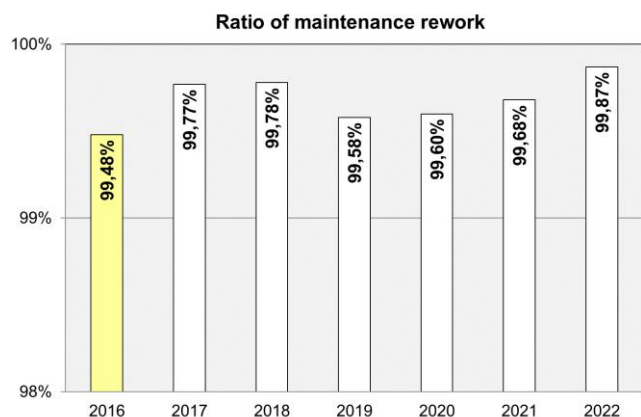
In most years no significant volume of this waste type was generated. In 2021 and 2022 the dominant volume of high level radioactive waste was represented by the intermediate rods.

A.II State of Structures, Systems, Components

A.II.1 Maintenance

A.II.1.1 Ratio of maintenance rework

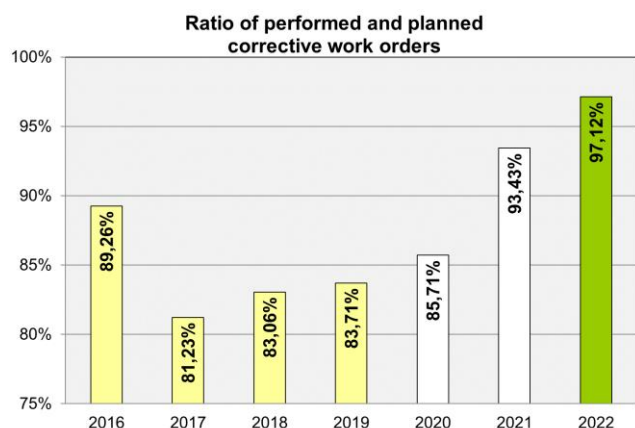
The ratio of maintenance rework indicator reflects the ratio of the number of equipment failure log records during a 6-week period after maintenance outage to the number of work orders completed during annual maintenance outage.



The annual values of the indicator are in 2022 for Units 1,2 and 3: 99.85%, 99.89%, és 99.87%. The power plant average value is 99.87%, which means that only 0.13% of the components maintained during outages had to be re-maintained within 6 weeks.

A.II.1.2 Ratio of performed and planned corrective work orders

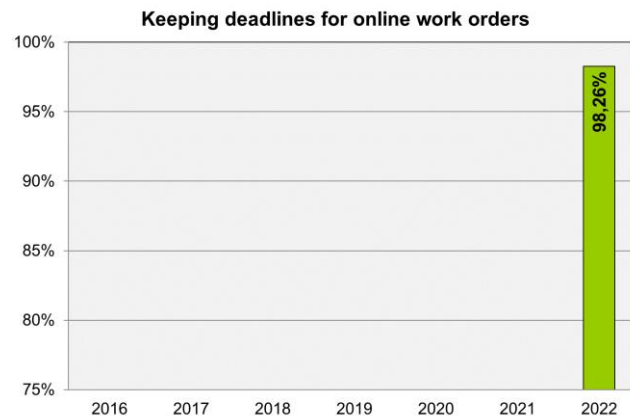
This indicator provides information on the ratio of the items of planned corrective maintenance work completed to the schedule.



The indicator has continuously improved in the past five years and exceeded the annual target value in 2020. The indicator value is excellent in 2022.

A.II.1.3 Ratio of performed and planned weekly work orders

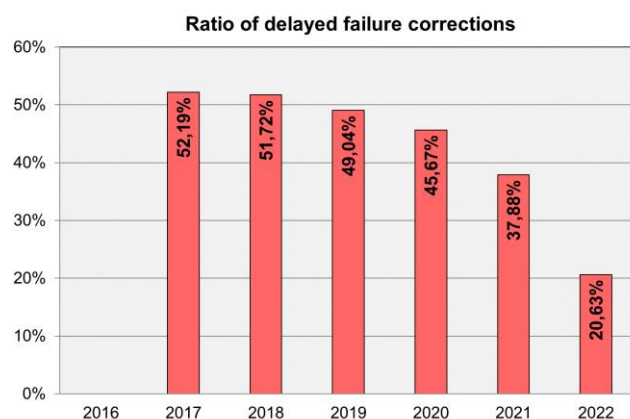
This indicator provides information on the ratio of the items of planned operative maintenance work completed to the schedule.



Due to the implementation of the new 12-week work management system, this indicator was introduced instead of the previous "Ratio of performed and planned weekly work orders" indicator.

A.II.1.4 Ratio of delayed failure corrections

The indicator is part of the system from 2017, it provides information on whether correction of failure of equipment was finished within the deadline specified or not.



The improvement in the value of the indicator in 2021 is due to the introduction of the new work management system in the second half of the year. In 2022, the previously experienced favorable trend continued, but further improvement is still needed.

A.II.1.5 Ratio of unsuccessful internal technical safety inspections

Almost half of the technical safety inspections are structural inspections; there are also pressure tests, integrity tests, super-control inspections and adjustments.

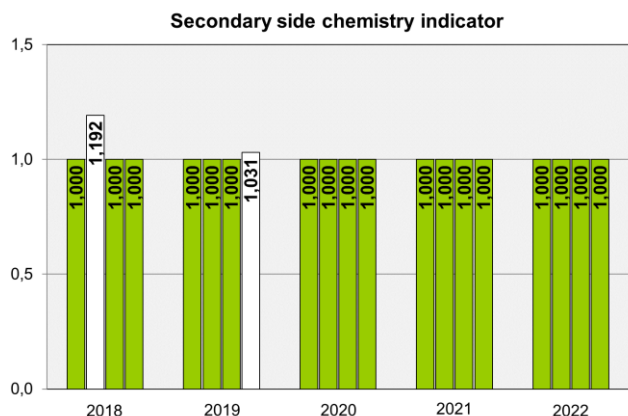


Except for 2016, the indicator contains the results of technical safety inspections performed after the maintenance. Except 2016, the value of the indicator was successfully kept below 2 percent. With the introduction of the 15-month fuel campaign the inspection method of the safety valves has also changed. The safety valve inspections according to ASME have resulted in unsuccessful qualification in several cases, it can be seen in the indicator value for 2016.

A.II.2 Material Conditions

A.II.2.1 Secondary side chemistry indicator

This indicator monitors the concentration of selected impurities in steam generator blow-down and in the feed-water. Its value is 1, if the concentration of contamination does not exceed the allowable value.



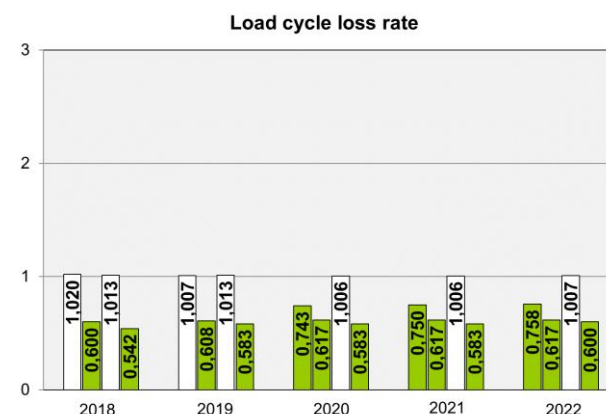
Since 2018 the secondary side chemistry indicator has been calculated based on the concentrations of sodium, chlorine, calcium and sulphate measured in the feed-water, as well as on the conductivity. In 2020-2022, the concentration of monitored contamination remained permanently below the limit value in each of the four units.

A.II.2.2 Load cycle loss rate

In the course of designing the main mechanical equipment of the nuclear power plant, the allowed number of loading cycles for the total planned lifetime of the equipment was determined considering various anticipated normal, incidental and accidental operational modes. A high safety margin was taken into account in the calculations. The indicator expresses the ratio of the actual loss rate of cycle numbers related to loss rate, calculated for the 30 years lifetime of the plant.

In the course of preparation for the plant lifetime extension, it was necessary that all these basic strength calculations should be carried out once again in respect of an extended lifetime with consideration to the gained experience to date, based on a renewed load catalogue.

In the legal sense, the licensing process of the new cycle register in respect of the four units was completed in 2014, thus, in 2014 the new countdown was started in respect of this indicator generation. The indicator in an indirect way shows the consumption rate of allowed cycle numbers in case of monitored loads.

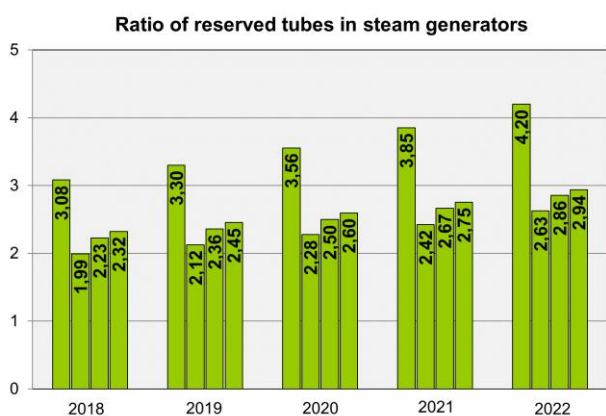


As of the up-to-date state of the year 2022, the lifetime margins are acceptable.

A.II.2.3 Ratio of reserved tubes in steam generators

The heat transfer tubes of the steam generator separate the radioactive primary water from the non-radioactive secondary side feed-water. The steam required for driving the turbines is produced in the steam-generators. These heat transfer tubes undergo a thorough material inspection during the annual maintenance, and are plugged if the indication of a crack in a tube exceeds a certain criteria. The plugged tubes reduce the reserve heat transfer surface originally planned to be 10%.

The indicator analyses the relationship between the actual loss rate of the reserve tubes and the normal loss rate calculated for the total lifetime (50 years).

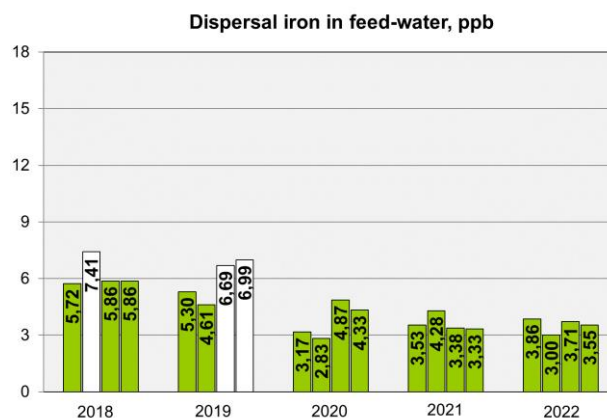


In case of each steam generator of each power unit this indicator demonstrates that the loss rate of reserve tubes is significantly below the allowed value, thus the sufficient heat transfer surface will be available until the end of the extended lifetime to assure the nominal production capacity of steam generators.



The refueling machine

A.II.2.4 Dispersal iron in feed-water



In 2020-2022 the disperse iron concentration of the feed-water at all Units was lower than the higher values observed over the previous years.

A.II.3 State of physical barriers

The third principle of nuclear safety is the need to have in place provisions which prevent the release of radioactive materials into the environment. As a technical means of compliance with the principle, the designer of the nuclear power plant applied engineering protective barriers. Accordingly, staff, the population and the environment are protected from radioactive substances by a series of leak proof barriers. The classic protective series of barriers is composed of three elements.

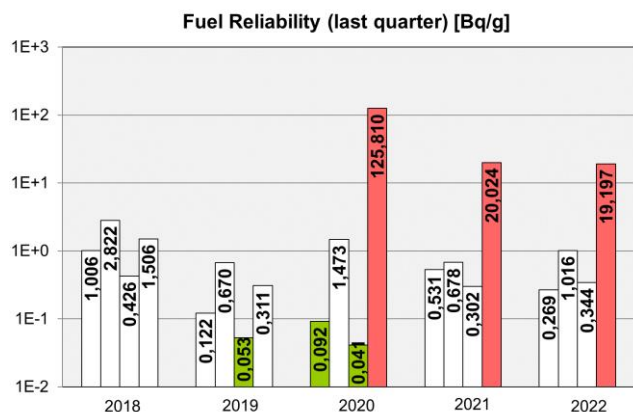
The first barrier is the casing of the fuel pin which, in an ideal case, prevents the release of radioactive isotopes created in the process of nuclear fission into the coolant.

The wall of the primary cooling system designed to withstand high pressure, acts as a second barrier for preventing the release of radioactive contamination entering the coolant due to the possible leakage of the pin or activated in the coolant for other reasons.

The third protective barrier is the wall of the hermetically sealed space composed of the premises containing the primary equipment and the localisation tower. It has the primary function of preventing the release of radioactive contaminants into the environment which entered the hermetically sealed space in the course of a maximum design basis accident. The three indicators below serve for the monitoring of the state of the barriers.

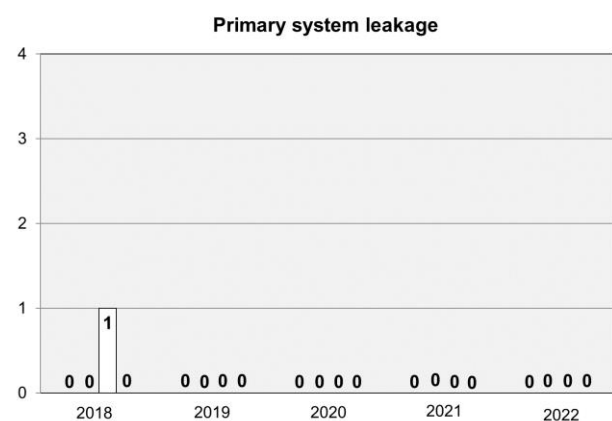
A.II.3.1 Fuel Reliability

The indicator corresponds to the WANO fuel reliability indicator. The chart shows rating based on the System of Safety Indicators at the end of the year, for each unit.



In 2018-19 the indicator did not point out any leaks in stationary operational mode, however during the 2019 outage of Unit 2, the sipping test of the fuels assemblies ultimately loaded out from the core identified one leaking fuel assembly. In November 2020, measurements conducted at Unit 4 indicated the possibility of a leaking fuel assembly. The suspicion of leaking fuel assembly remained in 2021 and 2022.

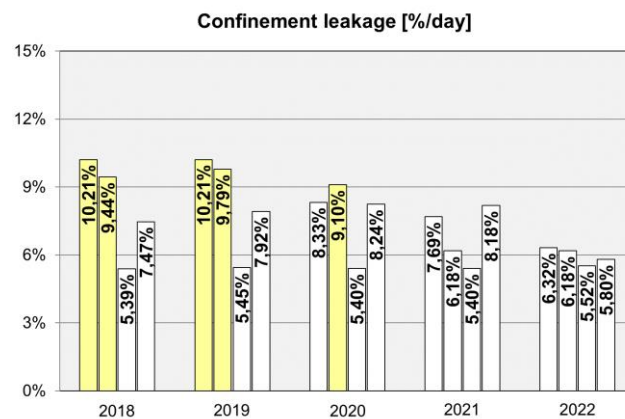
A.II.3.2 Primary system leakage



During the past 5 years the primary system leakage was observed once. In 2018 the leakage on a safety valve at Unit 3 had to be eliminated.

A.II.3.3 Confinement leakage

This indicator gives the leakage rate measured during the integrated confinement leakage test (ICLT) for each unit following the refuelling outages. (The allowed limit is 14,7 %/day.)



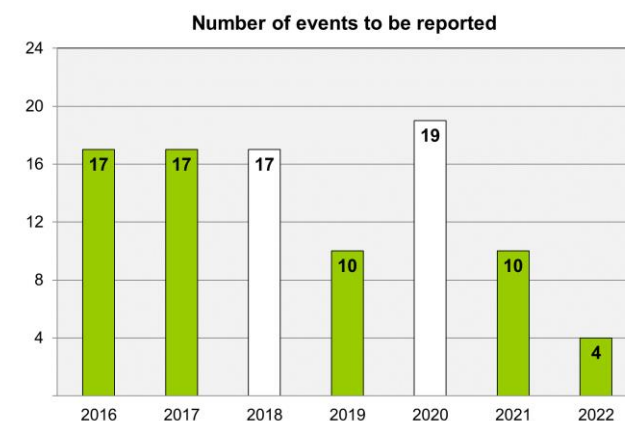
Based on the confinement leak test results it can be declared that in 2022 the values for all units meet the authority limit within considerable large margin. At the same time in 2017 at Unit 1 and in 2018 at Unit 2 the indicator value exceeded the intervention level due to which, the responsible department launched a comprehensive multi-annual monitoring and corrective action program. The results of this program can be seen in the 2021 and 2022 values.

A.III Events

A.III.1 Reported events

A.III.1.1 Number of events to be reported to the regulatory body

According to the Nuclear Safety Code (NSC), the nuclear power plant is required to submit to the hungarian nuclear regulatory body an event report if an event meets the reporting criteria. An Hungarian Atomic Energy Agency resolution defines the scope of events subject to reporting. This indicator constitutes one of the key indicators of nuclear safety.

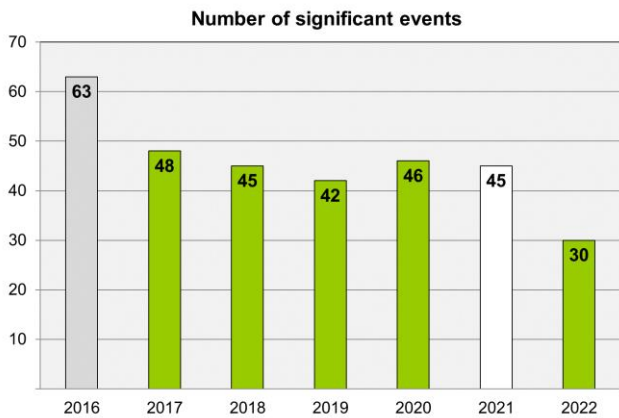


The number of events to be reported has remained below 20 since 2014. In 2019, the number of reportable events has decreased significantly. It should be noted that the change in the reporting requirements in April 2019 contributed significantly to the decrease. In 2020, the value of the indicator was at a level similar to those in the years before 2019. In 2021 the indicator was again kept at a low value. The extremely low value of 2022 can probably be considered exceptional.

A.III.2 Other events

A.III.2.1 Number of significant events investigated internally

According to the procedure such investigation is required if other important but not reportable events occur.



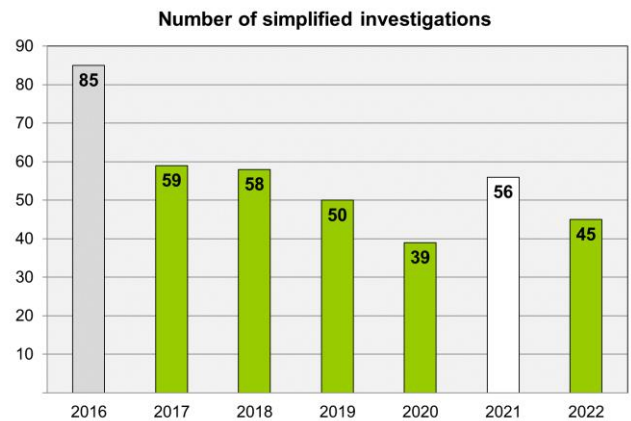
A minor modification of the investigation criteria used for the non-reportable events took place in 2015, which resulted in the introduction of simplified technical investigation. This modification has resulted in the decrease of the number of area-related investigations. In 2017-2021, the indicator has remained within the range of 40-50. The value for 2022 is significantly lower.



New makeup water preparation system

A.III.2.2 Number of simplified investigations

This indicator was introduced into the system as the independent one in 2017.

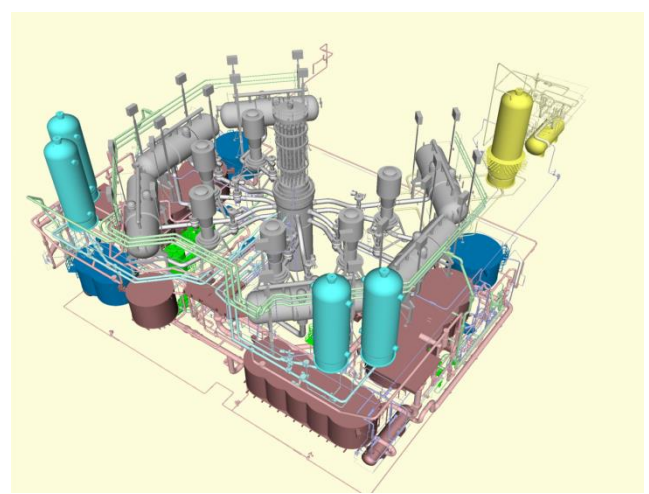


In 2017-2020 the value of the indicator has been characterized by a declining trend throughout. The value of the indicator in 2021 is slightly above average, while in 2022 it is below average.

B. OPERATIONAL SAFETY

B.I Safety Systems and Equipment

According to the first two principles of nuclear safety, provisions must be in place for the safe shutdown of the reactor and its maintenance in a safe shutdown condition, and the removal of residual heat following the shutdown of the reactor, during and after assumed operational events and design basis accidents. Such provisions are the safety systems and equipment.

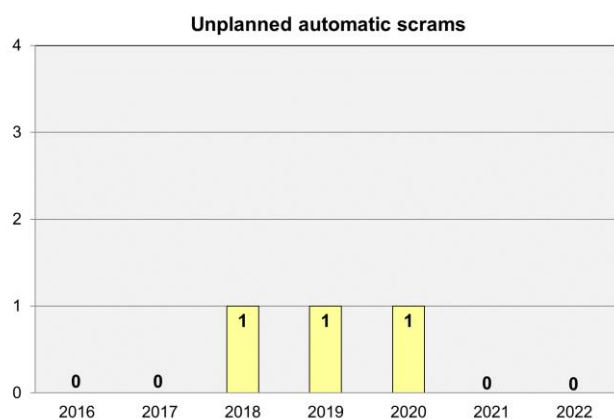


3D arrangement of the equipment of the main coolant circuit and the safety system components

B.1.1 Actuations

B.1.1.1 Unplanned automatic reactor scrams

While the WANO indicator shows the number of automatic reactor scrams during a period of 7000 critical hours, the System of Safety Indicators shows the absolute number of actuations.

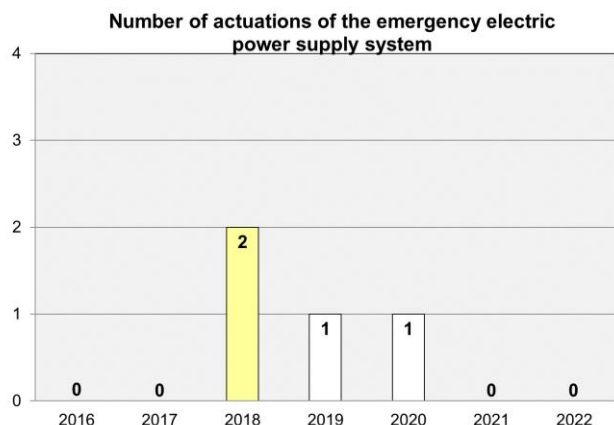


In 2018 the scram was actuated at Unit 3 while handling transient processes occurred due to the impact of electrical protection actuation from the external network. In 2019, an unreasonable protection actuation at one of the transformers in Unit 4 triggered the trip of the reactor. In 2020, temperature measurement of the lubricant in a turbine bearing with short-circuit fault triggered a transient, which eventually led to the trip of the reactor in unit 4.

B.1.1.2 Number of actuations of the Emergency Core Cooling System

Similarly to the previous years, no actuation of the Emergency Core Cooling System occurred in 2021 in critical state of the reactors.

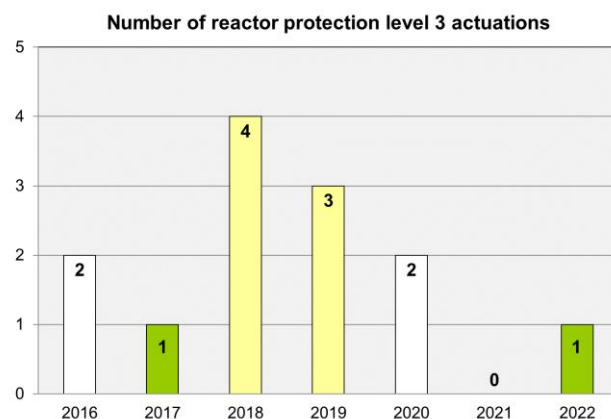
B.1.1.3 Number of actuations of the emergency electric power supply system



The number of events resulting in activation of the emergency power supply system was within a range of 0-2 over the past seven years. No such event occurred in 2021 and 2022.

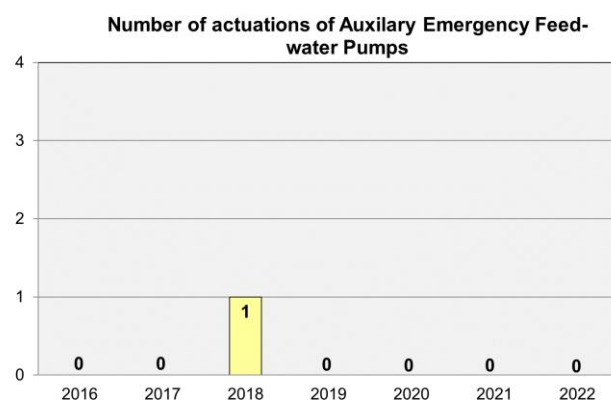
B.1.1.4 Number of reactor protection level 3 actuations

As a result of a reactor protection level 3 actuation the reactor power is gradually reduced by lowering control rod groups, with normal operational speed.



In 2022 during operation there was one event which caused reactor protection level 3 actuation because of human error.

B.1.1.5 Number of actuations of the Auxiliary Emergency Feed-water System Pumps



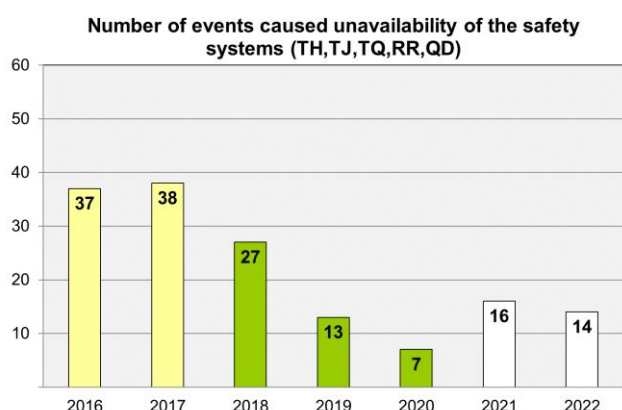
In 2018 an operational event at Unit 3 accompanied by the RP-1 actuation, there was water injection to the steam generator via the auxiliary emergency feed-water system.

B.1.2 Safety systems performance (availability)

The indicator of the availability of the TH, RR and QD systems corresponds to the indicators included in the WANO indicators chapter. Note that in the presentation of the availability indicator, actually, the non-availability value is presented in the graph.

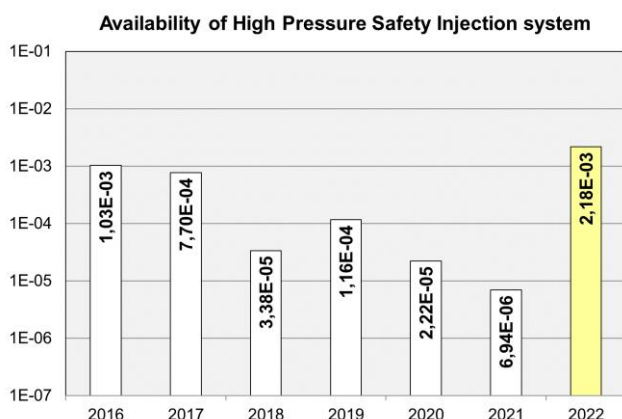
B.1.2.1 Number of events caused unavailability of the safety systems

This value includes both the planned and unplanned unavailability as well as the failures.



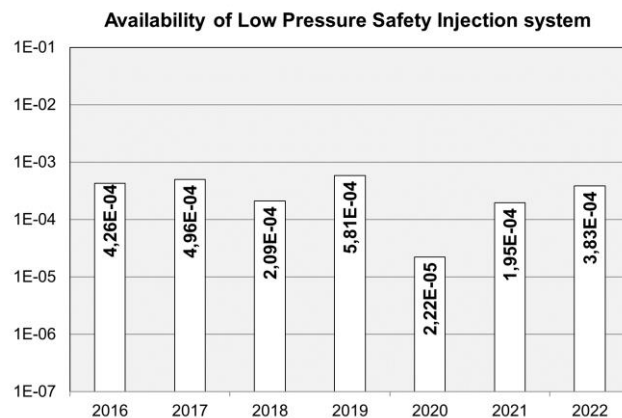
In 2017-2020, the number of events causing unavailability decreased further in the monitored systems. In 2021, this favorable trend was broken.

B.1.2.2 Availability of High Pressure Safety Injection system



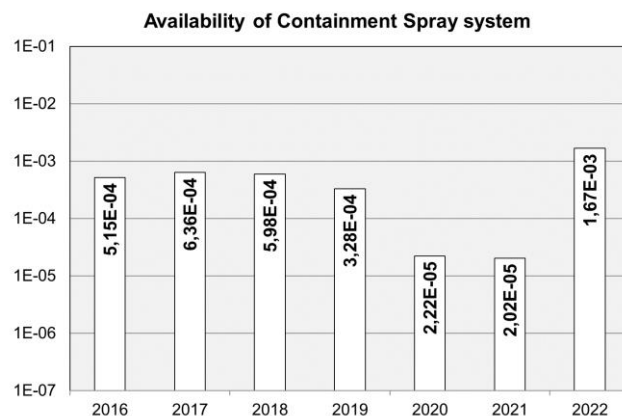
In 2022 inoperability of the HPSI system was declared 3 times, a duration of totally 210 hours was needed for recovery of them. This inoperability was caused by due to the repeated failure of the intermediate circuit cooling pump.

B.1.2.3 Availability of Low Pressure Safety Injection system



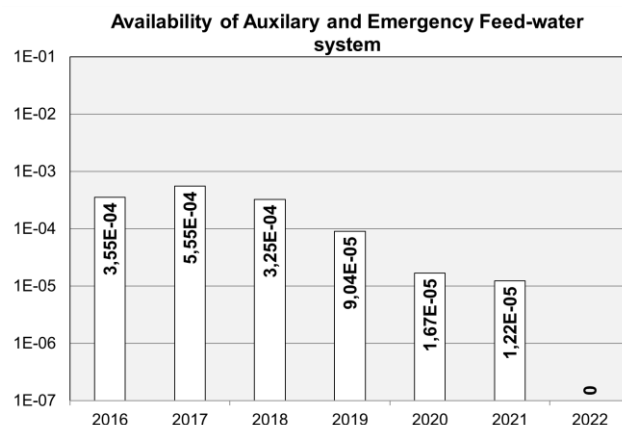
In 2022 inoperability of the LPSI system was declared 6 times, a duration of totally 37 hours was needed for recovery of them.

B.1.2.4 Availability of Containment Spray system



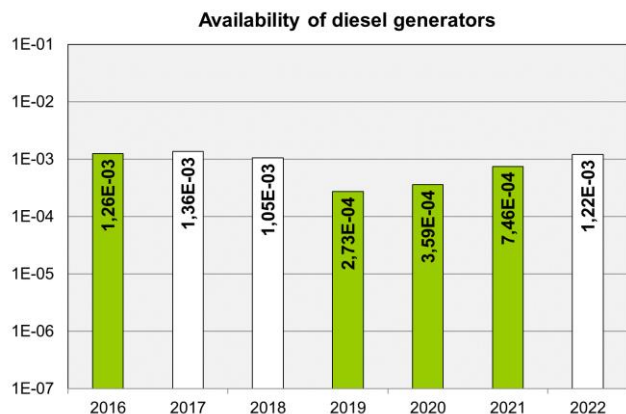
In 2022 inoperability of the CSS system was declared 4 times, a duration of totally 161 hours was needed for recovery of them.

B.1.2.5 Availability of Auxiliary and Emergency Feed-water system



In 2022 there was not detected any event caused inoperability at the Emergency Feed-water System and the Auxiliary Emergency Feed-water System.

B.1.2.6 Availability of diesel generators

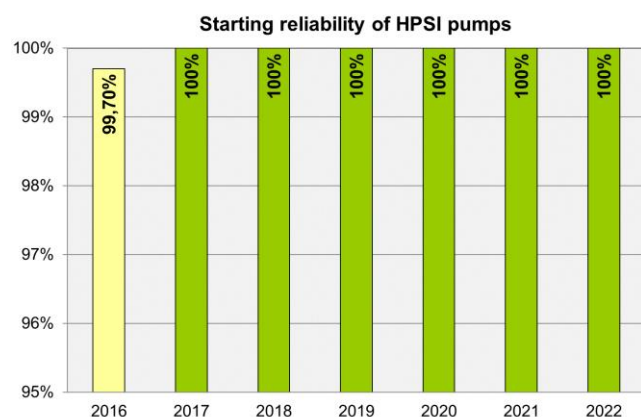


In 2022 inoperability of the DG was declared 7 times, a duration of totally 128 hours was needed for recovery of them.

B.1.3 Starting reliability

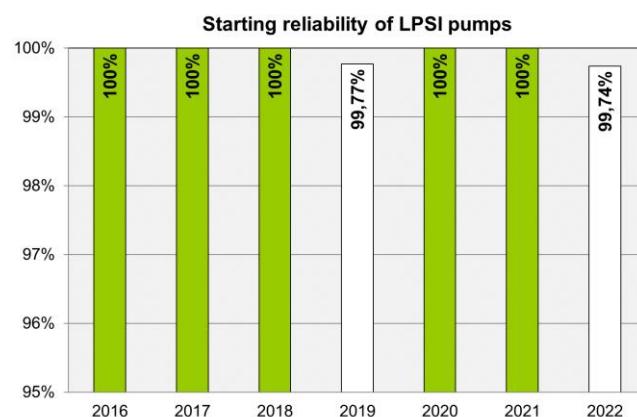
Availability of the safety systems is fundamentally affected by their active elements, such as pumps, which have to be ready for actuation, if necessary.

B.1.3.1 Starting reliability of High Pressure Safety Injection (HPSI) pumps



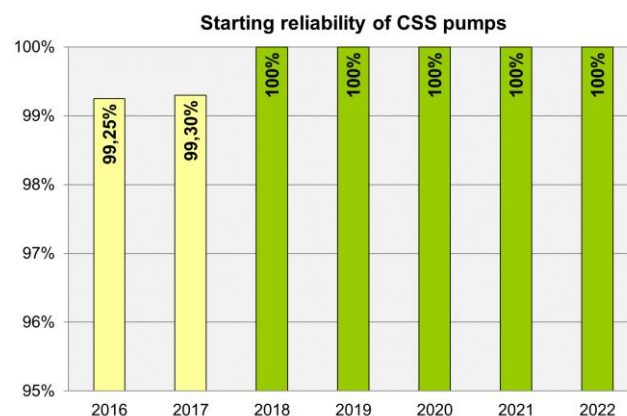
In 2016 on the HPSI system there was one unsuccessful start-up of a HPSI pumps due to breaker failure. In the other years there were no unsuccessful start-ups of the HPSI pumps.

B.1.3.2 Starting reliability of Low Pressure Safety Injection (LPSI) pumps



In 2019 and 2022 there was one unsuccessful start-up of the LPSI.

B.1.3.3 Starting reliability of Containment Spray System (CSS) pumps

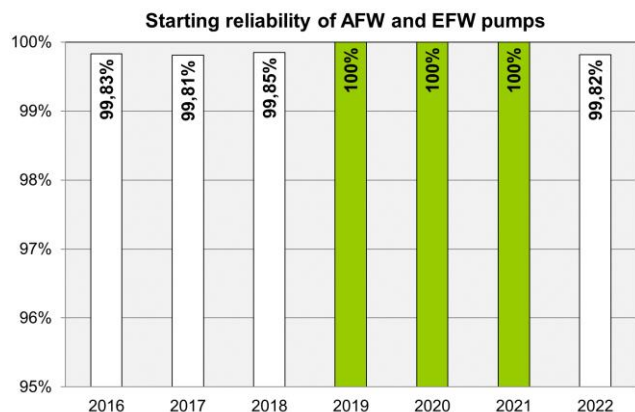


In 2016 and 2017 there were two unsuccessful sprinkler pump start-ups on the CS system, both caused by breaker failure. In the other years there was no unsuccessful start-up of the CSS pumps.



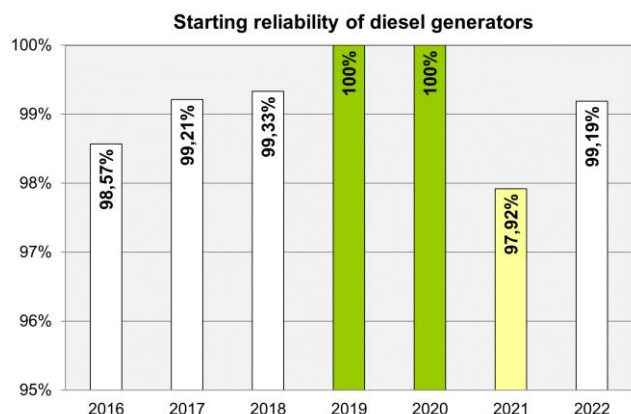
The diesel generator building for Units 1-2

B.I.3.4 Starting reliability of Auxiliary Feed-water (AFW) and Emergency Feed-water (EFW) pumps



In the 2016-2018 years and in 2022, one by one unsuccessful EFW pump start-up occurred.

B.I.3.5 Starting reliability of diesel generators



Diesels were started 123 times in 2022, 1 of which was qualified as unsuccessful.

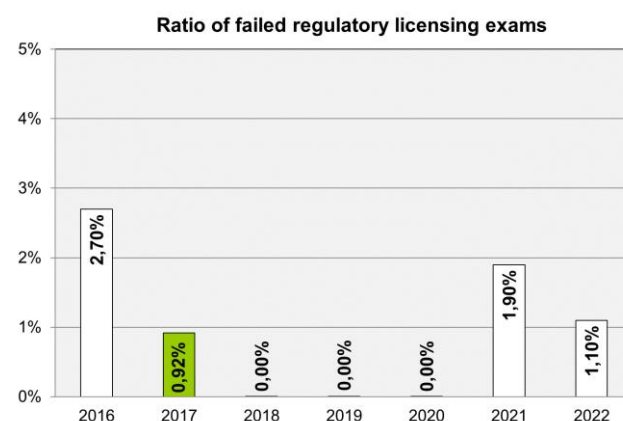
B.II Preparedness

B.II.1 Operational staff

With regard to employees working in positions of key importance in relation to the safety, the conducting of independent work is bound to passing an official or company licensing exam. Licenses are valid from the date of a successful licensing exam during a specified period of time or until withdrawal. The validity of the licenses must be extended within the validity period by passing a competency licensing exam.

B.II.1.1 Ratio of failed regulatory licensing exams

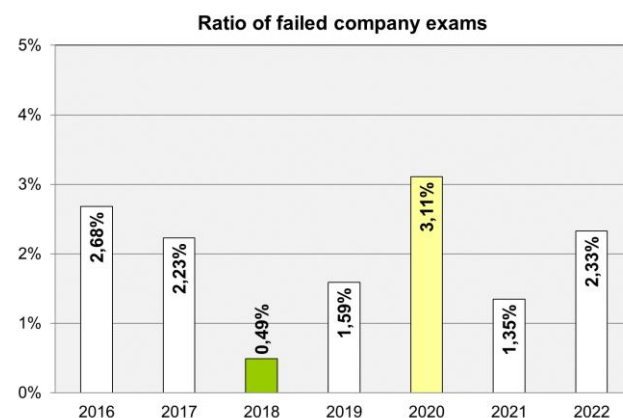
In accordance with current legislation, only three work positions, the Plant Shift Supervisor, the Unit Shift Supervisor and the Reactor Shift Operator, are obligated to pass a regulatory licensing exam. In 2014-2015 the indicator was generated directly by the number of failed licensing exams. Since 2016 once again the indicator is based on ratio, however the calculation method has been significantly changed, as from 2016 the refresher simulator exams are also taken into account, as failure on such exam also results in revoking the license.



In 2022 there was one failed regulatory licensing exams.

B.II.1.2 Ratio of failed company exams

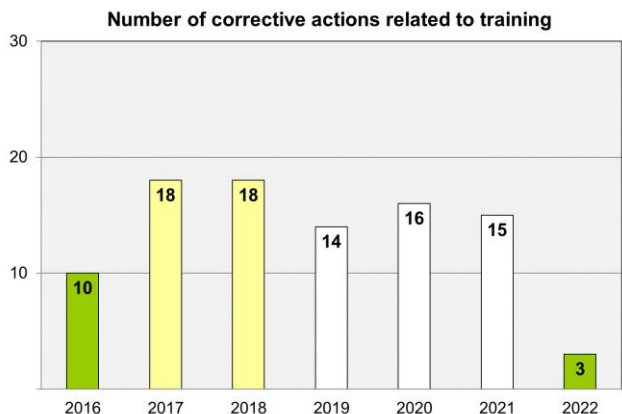
Staff working in key operating, maintenance and support service positions in relation to the safety of the nuclear power plant, not subject to official licensing examination regulation, but conducting work closely linked to the equipment of the nuclear power plant units classified into class 1 and 2 under the Safety Classification of Nuclear Power Plant Equipment, are obliged to take the company licensing exam.



In 2022 there were 9 failed company exams out of the total of 386.

B.II.1.3 *Number of corrective actions related to training*

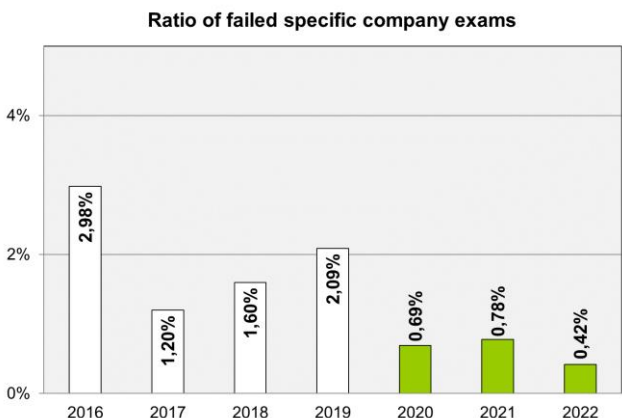
The indicator takes into account training related actions which are defined during the investigation of reportable events.



The number of corrective actions related to training identified during investigation of events to be reported indicates close relationship with the number of events with human errors and deficiencies classified into the category of human errors.

B.II.1.4 *Ratio of failed specific company exams*

After having changed the relevant regulations, a part of the work positions obligated to pass a licensing exam were re-categorized into the category of specific company exam positions. Consequently it is included in the System of Safety Indicators as an independent indicator from 2013. In 2016 this indicator was also renewed to contain the refresher simulator exams.



1 of 237 exams were failed during exams of employees obligated to pass a specific company exam in 2022.

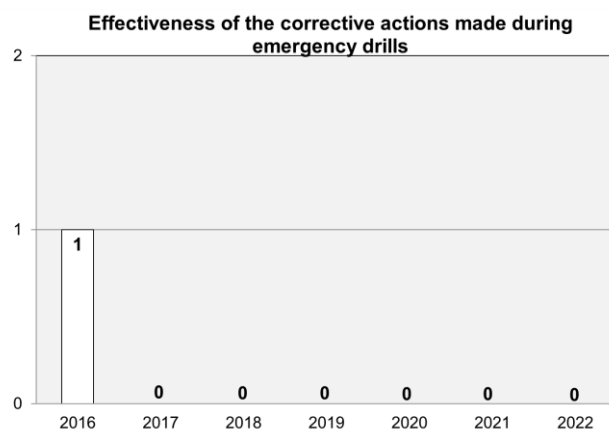
B.II.2 *Emergency preparedness*

B.II.2.1 *Average number of corrective actions decided during evaluation of the emergency drills*

Last seven years during evaluation of the emergency drills, no immediate corrective actions were required to be developed and implemented.

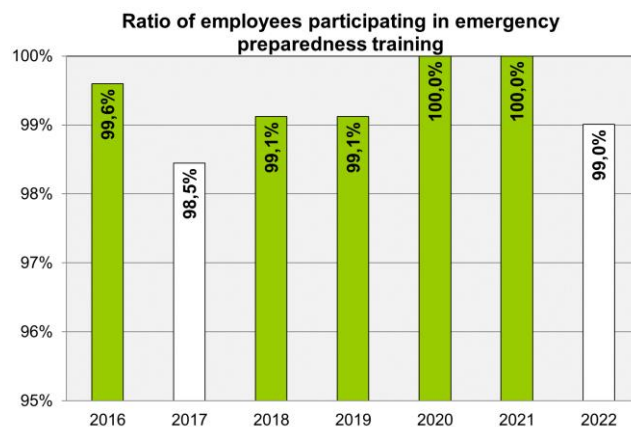
B.II.2.2 *Effectiveness of the corrective actions made during emergency drills*

The effectiveness of the corrective actions can be attributed to the recurrence of problems during the drills.



In 2022 repeated deficiency not occurred.

B.II.2.3 *Ratio of employees participating in emergency preparedness training*

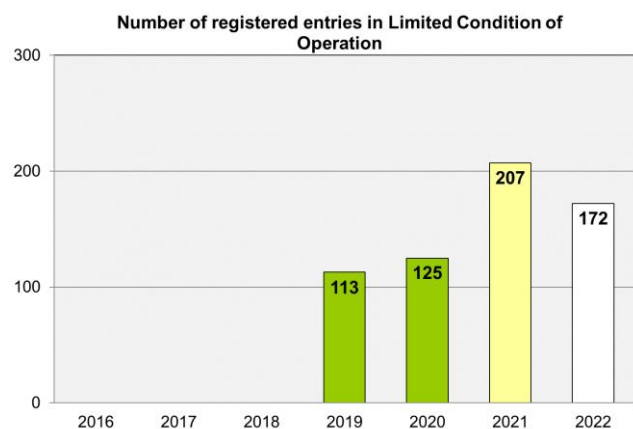


The ratio of employees involved in the emergency drills and training courses in 2022 was 99 %, which ensures that tasks to be performed during an emergency are widely known within the scope of people concerned.

B.III Risk management

B.III.1 Plant configuration risk

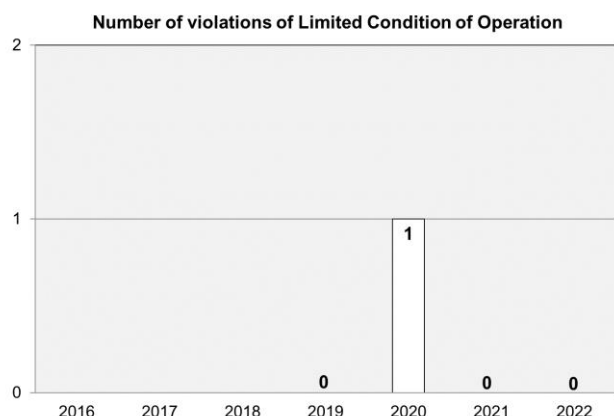
B.III.1.3 Number of registered entries in Limited Condition of Operation



From 24 October 2018 onwards the Technical Specification (TS) was replaced by the Limited Condition of Operation (LCO), thus this indicator was added to the system in 2019. The value of the indicator remained favorably low in the first two years after its introduction, but became significantly higher in 2021. After the modification of the LCO, the value of the indicator decreased.

B.III.1.4 Number of violations of Limited Condition of Operation

A violation of the Limited Condition of Operation (LCO) takes place if the limiting condition is not fulfilled as a result of an intentional decision or intervention to the contrary or due to disregard of the prescribed intervention. The violation also occurs if, in the case of any of the restrictive conditions in course of application of the LCO, the exit from the LCO does not take place within the prescribed period of time as a result of the implementation of a series of interventions related to successive, overlapping different conditions.

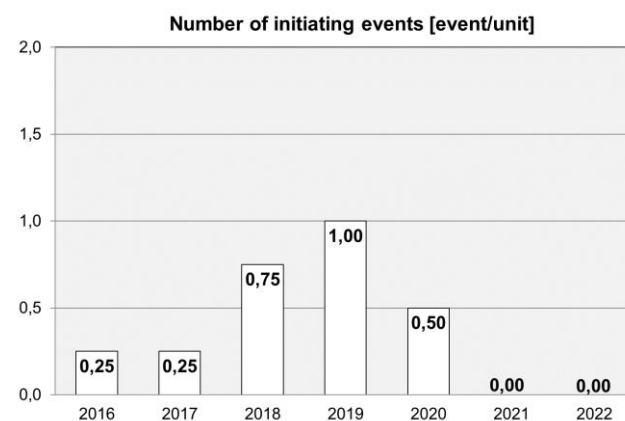


Since the implementation of the LCO, there has been one violation of the LCO. In 2020 in Unit 1, the staff put into operation the non-operating loop under M1 operational conditions slightly below the required 10% reactor performance, thus violating the LCO.

B.III.2 Initiating events

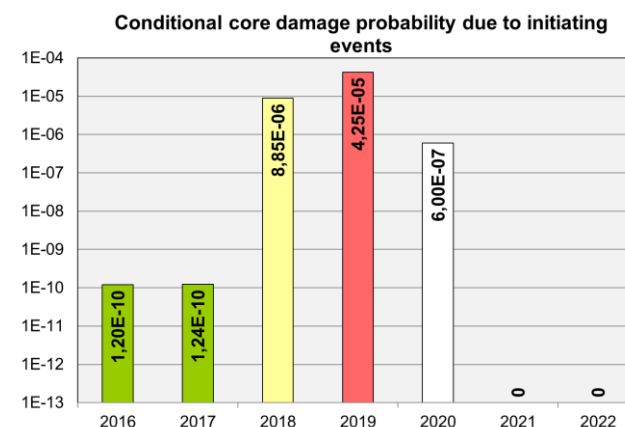
B.III.2.1 Number of initiating events

The initiating event is an event that results in a deviation from normal operational conditions, which occurs due to technical causes within the facility, an intervention on the part of the staff or an artificial or natural impact from the environment, and may lead to assumed operational events, design basis incidents or accidents.



In 2022 there were no initial events among the reportable events.

B.III.2.2 Conditional core damage probability due to initiating events



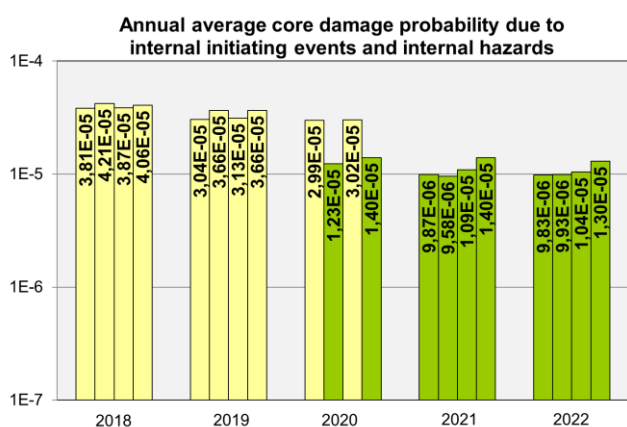
In 2022 there were no initial events among the reportable events.

B.III.3 Core damage risk

As a result of the implementation of the risk monitor, the previous indicators have been replaced by new indicators in this group.

B.III.3.5 Annual average core damage probability due to internal initiating events and internal hazards

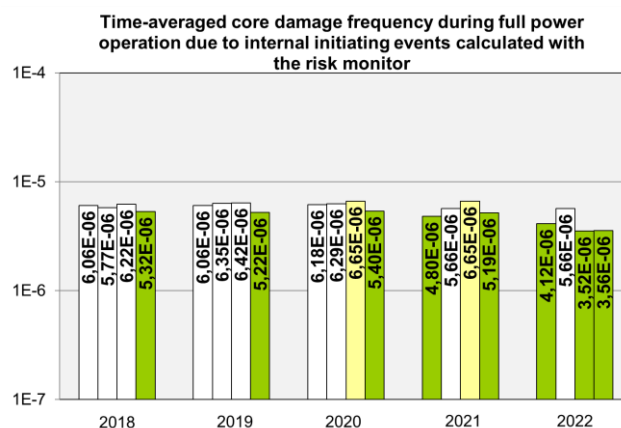
This indicator shows the annual average core damage probability due to internal initiating events and internal hazards. It is calculated using the updated Level 1 PSA results in accordance with the Final Safety Analyses Report.



Before 2020 the value of the indicator was based on the assumption, that in some cases the negative effects of flooding affect more rooms than the ones flooded directly, specifically those adjacent rooms which are divided by walls not necessarily resistant to the forces of flooding (typically brick walls). Modifications aimed at mitigating the risk were implemented in all four units in 2020-2021, the value of the indicator became favorable.

B.III.3.6 Time-averaged core damage frequency during full power operation due to internal initiating events calculated with the risk monitor

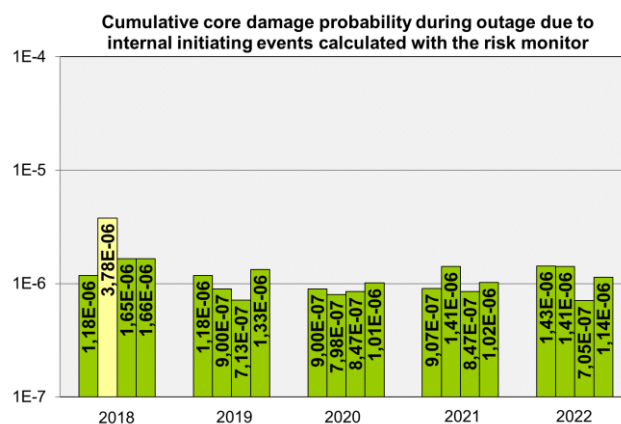
By means of the risk monitor the quotient of the realized cumulative risk calculated for full-power operation and the duration of full-power operation, which is calculated after the end of the campaigns. The purpose of the indicator is to demonstrate that the unit has operated during the campaign with the appropriate safety configuration, that its safety-related equipment were sufficiently available, and that the unit was prepared to deal with a possible operational incidents.



By means of safety-monitoring operation of the value of the indicator related to few malfunctions during operation might be kept at an appropriate level. In Unit 3 in 2020-2021, the basic risk level during the campaign showed an increased value, which was reduced to normal operating value in 2022.

B.III.3.7 Cumulative core damage probability during outage due to internal initiating events calculated with the risk monitor

The indicator shows the cumulative core damage probability resulting from the actually realized internal technological events, which is calculated on the basis of the risk monitoring, performed after the completion of the outages.



The indicator will be updated following the major overhaul, its values demonstrate the cumulative risk of the latest completed major overhaul in each Unit. By means of safety-minded maintenance and by planning of low-risk maintenance configurations, it is possible to keep the value of the indicator within the excellent range. This has been greatly promoted in recent years by multiple preliminary risk assessments of the outages, which have drawn attention to potentially inappropriate maintenance configurations that the maintenance planners have been able to avoid by redesigning the maintenance activities.

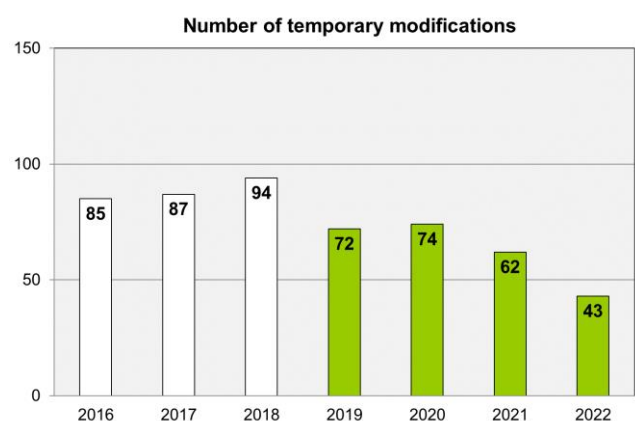
C. COMMITMENT TO SAFETY

C.I Human performance

C.I.1 Deviation from the design basis

C.I.1.1 Number of temporary modifications

Temporary modification is defined as series of actions resulting in a condition of mechanical, electrical, I&C, computational technology or radiation protection systems, which deviates from the as-built design, the parameters or switching values specified in the given operational documentation, or the switching states recorded in the operational documents. The deviating condition handled as a temporary modification shall be eliminated as soon as technically possible, that is, the design condition before the temporary modification shall be restored or the temporary modification shall be finalized.



During the past years, there has been a trend to a continuous slight growth in the indicator value. In 2019, the value of the indicator is favorably changed and remained at a same level in 2020. In 2021 and 2022 the value of the indicator improved further.



Installing an air cooler on top of the localisation tower

C.I.1.4 Number of temporary operating procedures

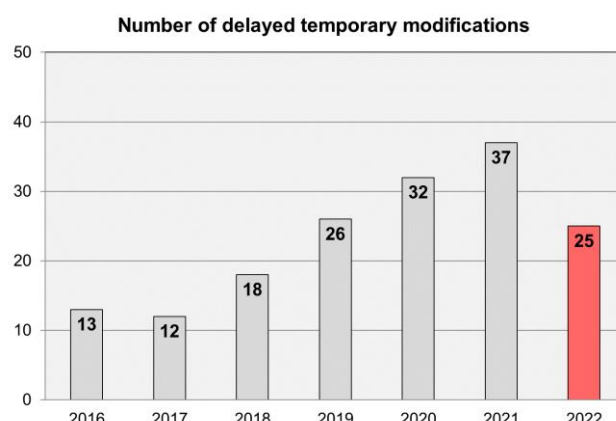
This indicator represents the number of temporary modifications of the operating documents, that is, the number of issued temporary operating procedures in the given year.



The values of the indicator have been favourable till 2018. In 2018 the instructions developed for the performance of in-service maintenance and management of the low water level in the Danube contributed to the indicator value increase. A significant part of these was successfully incorporated into the operating instructions. since 2021 an improving trend has started.

C.I.1.5 Number of delayed temporary modifications

In this form the indicator has been part of the system since 2022, prior to that an indicator called ‘Temporary modifications with late termination’ was used.



The value of the indicator increased significantly in both 2018 and 2019, so corrective measures were taken. These actions have slowed but not stopped the deterioration. Therefore, a new package of measures was introduced in 2021 to break the deteriorating trend. Continued strict and consistent compliance with

the remedial measures put in place could lead to a continuous of the improvement.

C.I.1.6 Number of temporary repairs

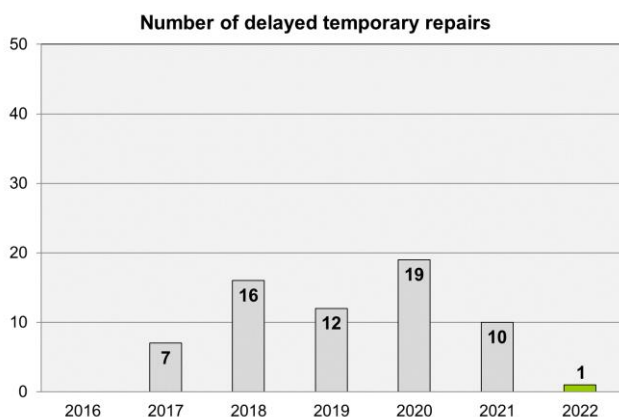
This indicator has been included based on international recommendation to monitor and ensure that the number of temporary repairs remain at the level as low as reasonably achievable.



The value of the indicator has decreased significantly over the past two years from over 100 to below 100.

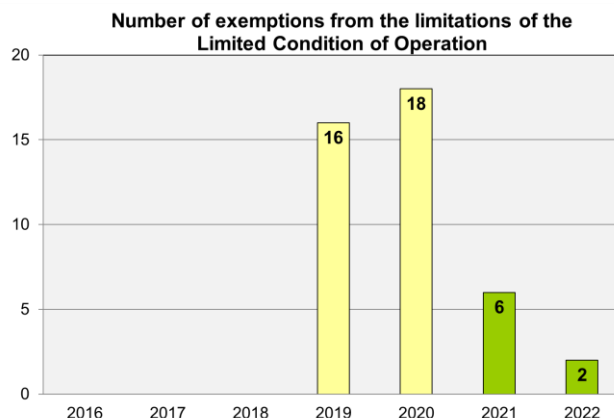
C.I.1.7 Number of delayed temporary repairs

In this form the indicator has been part of the system since 2022, prior to that an indicator called "Temporary repairs with late termination" was used. The previous indicator has been included based on international recommendation to monitor whether temporary repairs have been completed by the assigned deadline.



In 2022, significant changes have been made to the work management system in the process of "work order recording - work order planning - temporary repair - final repair". This also contributed to the extremely low value of the indicator in 2022.

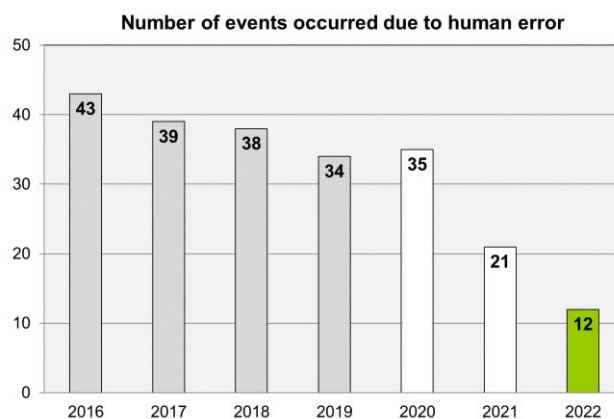
C.I.1.8 Number of exemptions from the limitations of the Limited Condition of Operation



It could have been expected that following introduction of the Limited Condition of Operation the number of exemptions will increase. In 2019, the professional organizations continuously negotiated on the development of a modified version of the LCO, which was authorized by the authority in August 2020. As expected, the implementation of new LCO version 1.2 significantly reduced the number of temporary exemption requests.

C.I.2 Human factor

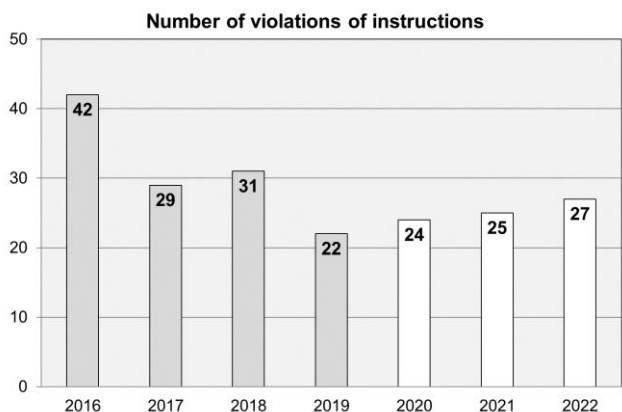
C.I.2.2 Number of events occurred due to human error



Before 2020, the 'Ratio of events occurred due to human error' indicator was part of the system. The indicator included human errors revealed during the inspection of reportable and non-reportable events. After a slight improving trend observed between 2017 and 2020, a significant decrease occurred in 2021 and continued in 2022.

C.1.2.3 Number of violations of instructions

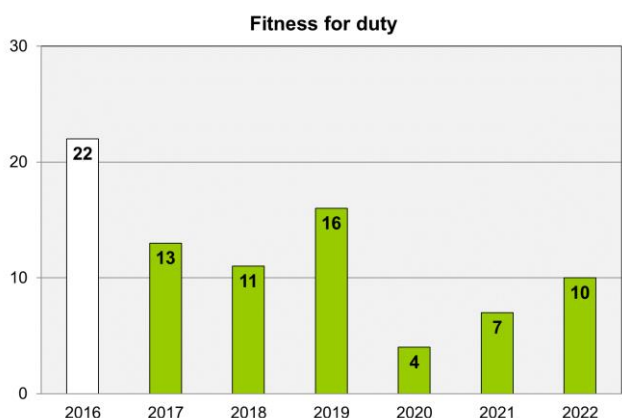
The indicator is represented the number of violations of instructions, determined during the investigation of reportable events and since 2016 during the investigation of significant events.



In this form the indicator has been part of the system since 2020, prior to that an indicator called 'Ratio of violations of instructions in human errors' was used. The value of the indicator in 2020-2022 is increased slightly.

C.1.2.4 Fitness for duty

This indicator represents the number of employees who entered the plant site and certifiably infringed the security regulation of the company on fitness for duty.



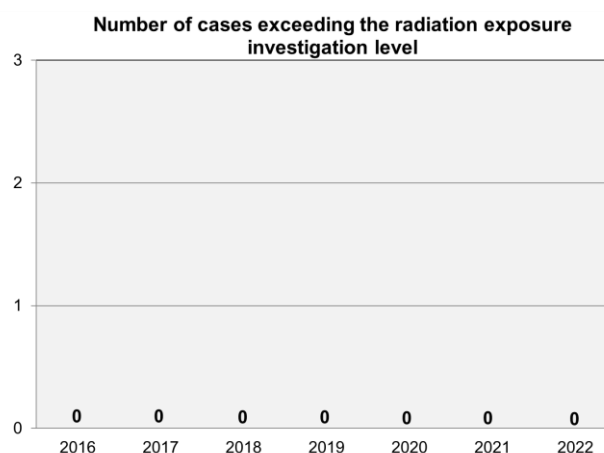
Due to the unfavorable changes of the indicator in 2015, in course of the annual refreshing trainings we constantly draw the attention of the employees to the compliance with the rules concerning the working capability, and furthermore, in the spring of 2016 knowledge refreshing lectures were held as part of the alcohol and drug prevention program. The indicator has continuously improved in period of 2016-2018. In 2020, as a consequence of home office introduced due to the pandemic situation, the number of entries

decreased, and so did the number of inspections in order to minimize contact. This is demonstrated by the value of the indicator.

C.1.3 Radiation protection program effectiveness

C.1.3.1 Number of cases exceeding the radiation exposure investigation level

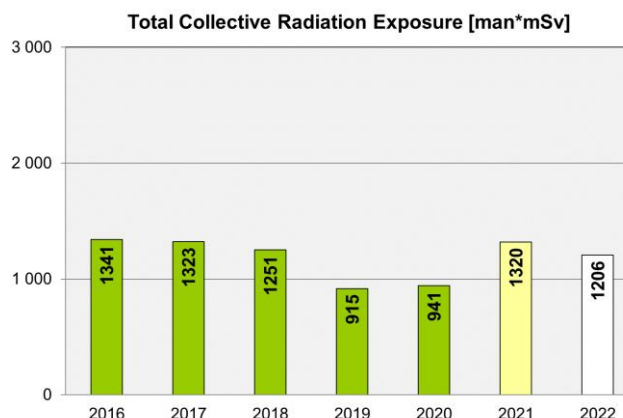
In order to timely identify and eliminate potential deviations from the radiation safety norms, the Plant Radiation Protection Code of Paks Nuclear Power Plant specifies those control levels, the exceedance of which results in the performance of an investigation procedures by the professional organisation.



Last seven years no event occurred when the dose rate measured by a regulatory dosimeter to be worn for two months exceeded the investigation value.

C.1.3.2 Total Collective Radiation Exposure

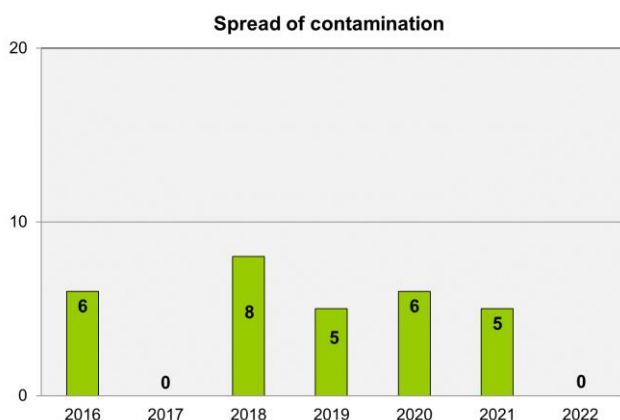
This indicator is the external exposure derived from whole body exposure and the internal exposure of all employees of the plant and the external contractors, as well as of the visitors.



Due to the implementation in 2016 of the 15-month fuel campaign, there has been a spike-like improvement of the indicator value. The value for 2019 is the lowest value of the entire four-unit operation so far. In 2021 the collective dose of the Unit 2 outage significantly exceeded the scheduled value, so the value of the indicator became higher. The value for 2022 can be called to be good.

C.1.3.3 Spread of contamination

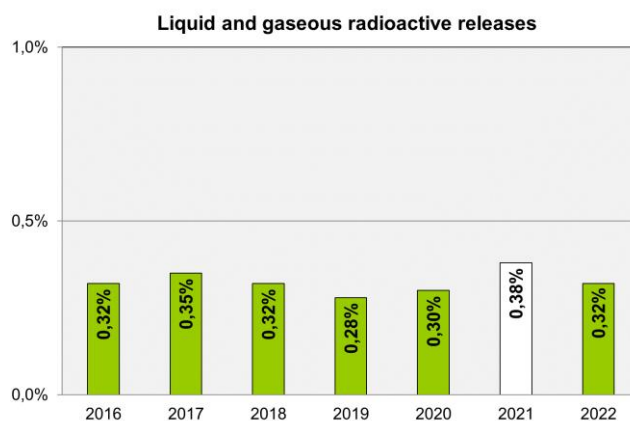
Besides the classification of rooms, the indicator applied to evaluate the spread of radioactive contamination within the controlled area is based also on the hot spots that exist for a period longer than three months (the dose rate in the so called hot spot is higher by minimum one order of magnitude than the average dose rate in the environment of the measuring point) that exist for a period longer than three months. For this indicator, the classification of the room into a higher category is considered as representing a five times higher value than the hot spot.



In 2022, no room had to be reclassified to a higher category and the hot spot did not contribute to the increase of the indicator value either.

C.1.3.4 Liquid and gaseous radioactive releases

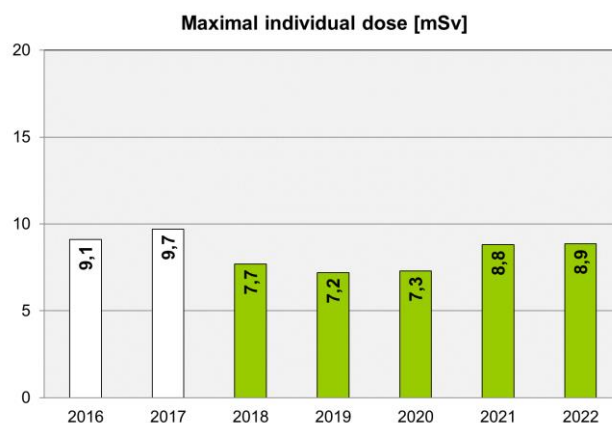
The radioactive discharge limits for the nuclear power plant are controlled by the KÖM (Ministry of Environment Protection) Decree no 15/2001. (VI.8.). The discharge limitation system compares the actual liquid and airborne discharges to the isotope specific discharge limits derived from the dose restriction (90µSv/year) specified for the nuclear power plant. The indicator represents the value of the cumulative limit utilization factor.



There was no discharge in 2022 in addition to the normal operational discharges. The Radiation Protection Section calculated the extra radiation exposure of the public using the releases and meteorological data, and the spreading model. According to this model, the extra radiation exposure of the public due to liquid and gaseous releases was 110 nSv in 2022. This amount of 110 nSv each person gets from natural background radiation in about one hour.

C.1.3.5 Maximal individual dose

The extent of radiation exposure which is allowed to be suffered by employees of the Paks Nuclear Power Plant during one year and a period of five years, respectively, is strictly prescribed by laws. In order to comply with dose limits the nuclear power plant specifies control levels, one of them is the annual control level of radiation exposure, the value of which is 12 mSv. The highest individual dose indicator serves for observing it, this indicator is part of the system of safety indicators since 2012.

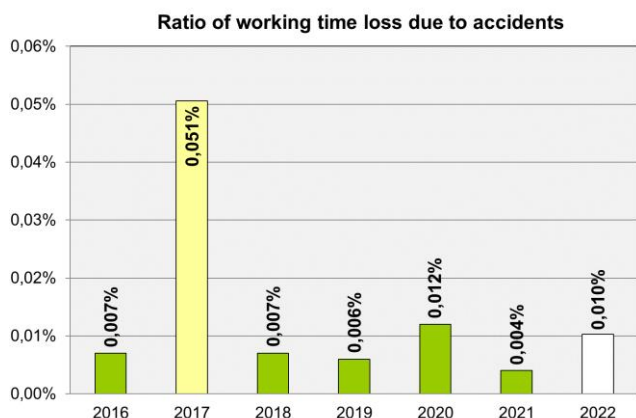


It is visible that the highest dose values are below even the control levels.

C.1.4 The effectiveness of the industrial safety program

C.1.4.1 Ratio of working time loss due to accidents

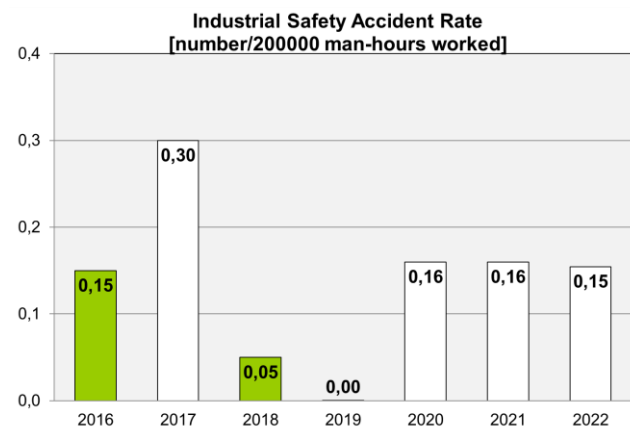
This indicator reflects how much working time was lost in the consequence of accidents compared to the full time worked.



In 2022, the industrial accidents did not lead to long working time losses.

C.1.4.2 Industrial Safety Accident Rate

The indicator corresponds to the WANO industrial safety accident rate.

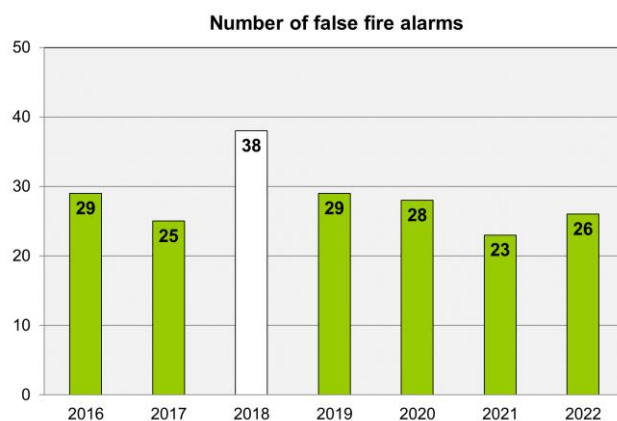


The accidents for occurrence of which material, environmental, organizational and administrative omission was not established against the company, are not included in forming of the indicator.

The indicator reached the best value in 2019 since its introduction, but also showed an acceptable value in 2020-2022.

C.1.4.3 Number of false fire alarms

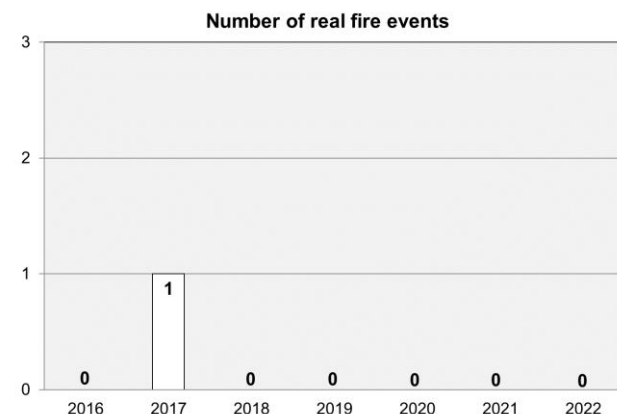
This indicator provides information on the reliability of the several thousand fire signal devices installed in the power plant.



In 2022 an average number of false fire alarms occurred.

C.1.4.4 Number of real fire events

The indicator represents the fire events reported to the regulatory body as specified in Nuclear Safety Code Guide 1.25.



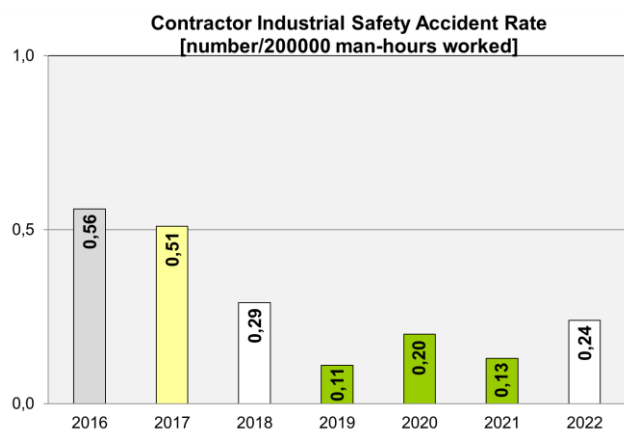
During the last seven years one fire event occurred. In 2017 in the auxiliary building the mechanics noticed fire in the hydrogen-peroxide transfer pump, electric motor, connecting piping and drip tray located in one of the rooms of the auxiliary building. The fire was choked with a portable fire extinguisher.



Safety culture campaign in 2022

C.I.4.5 Contractor Industrial Safety Accident Rate

The indicator was introduced into the system in 2017 and is managed in a manner identical to that used in case of the company's own staff.



The indicator continuously improved between 2016 and 2019, and in 2019-2021 it has been rated excellent. The 2022 value can be assessed as good.

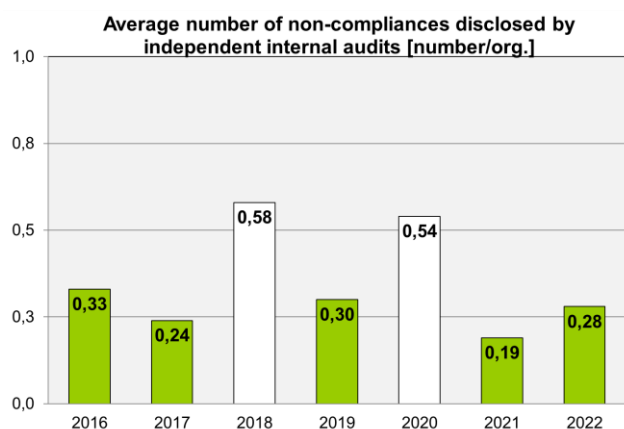
C.II Striving for improvement

C.II.1 Independent- and self-assessment

The self-assessment indicators examine the efficiency of the safety and quality control audits.

C.II.1.3 Average number of non-compliances disclosed by independent internal audits

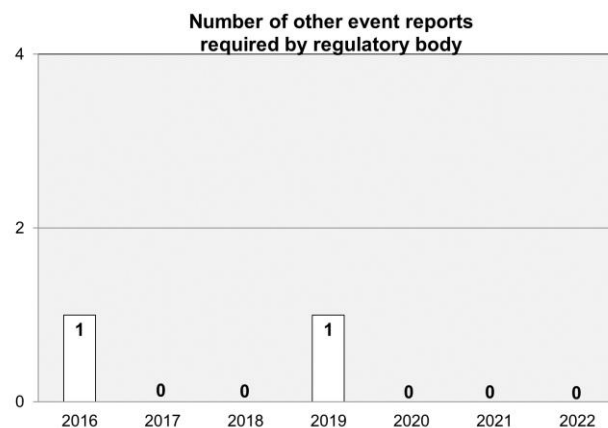
The indicator is the average number of non-compliances per one audited organisation.



In most of the past years, the indicator has been rated excellent.

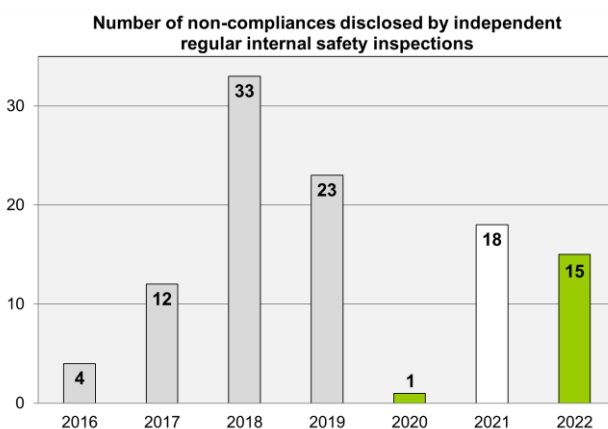
C.II.1.5 Number of other event reports required by regulatory body

The indicator included the investigations requested by the regulatory body, which were not initiated by the plant based on its internal criteria.



In recent years, it has been rare that an investigation under the criteria was not initiated by the plant.

C.II.1.6 Number of non-compliances disclosed by independent regular internal safety inspections



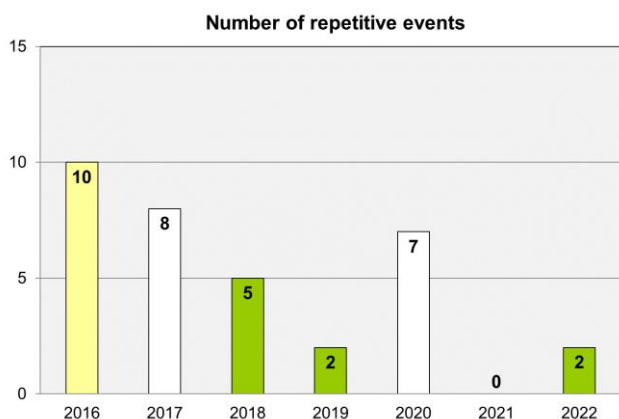
In this form the indicator has been part of the system since 2020, previously an indicator called 'Ratio of non-compliances disclosed by independent regular internal safety inspections' was used.

In 2020, due to the pandemic situation, the safety engineers were able to carry out fewer inspections. Moreover, the majority of inspections were not conducted on site, but in the information technology systems. Due to the significantly fewer number of inspections and the lack of on-site presence, the number of non-compliances disclosed was extremely lower compared to the previous years. In the second half of 2021, it was already possible to carry out on-site inspections again, so the number of observations increased to the previous average level.

C.II.2 Operational experience feedback

C.II.2.1 Number of repetitive events

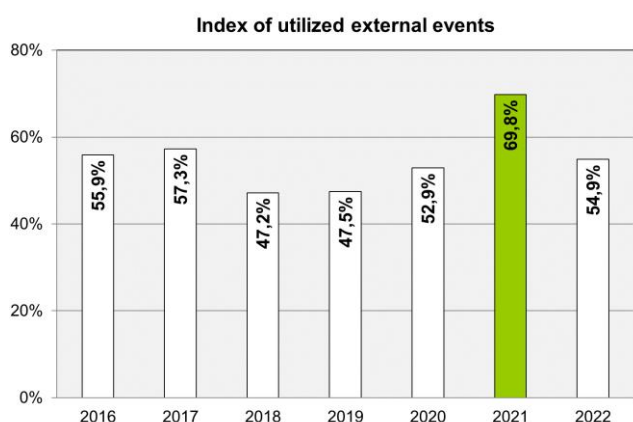
During the generation of this indicator we took into consideration those reportable events which had already occurred earlier due to the same reasons and under the same circumstances, and the corrective measures determined as the result of investigations were aimed solely at preventing their re-occurrence, since the prevention of their re-occurrence is justified from the nuclear safety point of view.



From 2017, a decreasing trend has developed, in which the 2020 year value is an exception.

C.II.2.2 Index of utilized external events

WANO and the International Atomic Energy Agency grant access to the database of events occurring in the member power plants. For the purpose of utilising foreign experience, the power plant continuously processes the reports on events with a view to utilising the drawn conclusions.

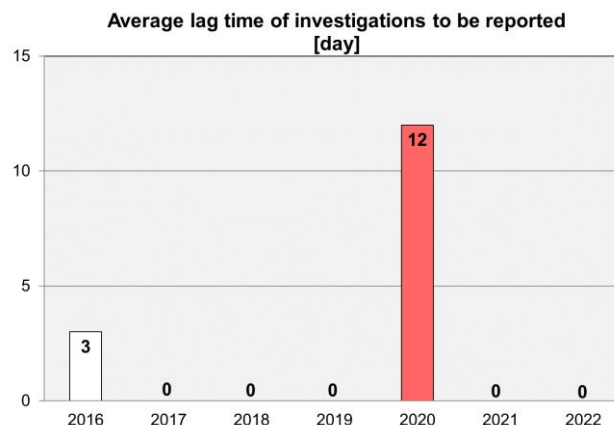


The received events are used in the utilisation process with varying relevance, depending on their type, as tracked by the indicator. Obviously, events of key importance in relation to safety are of highest priority.

In 2022, after screening the several thousand events received, 50 events have been utilized out of 93 processed ones.

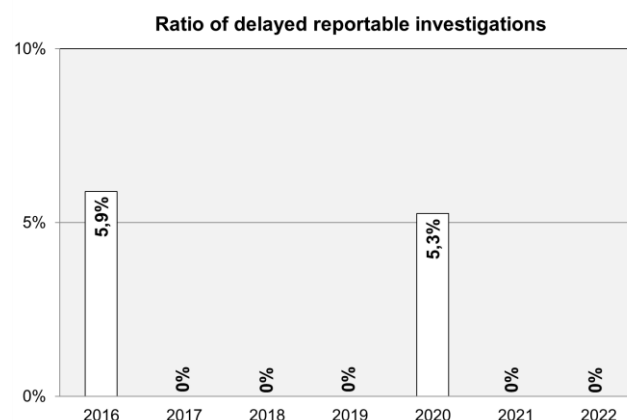
C.II.2.3 Average lag time of investigations to be reported

Subject to requirements of the Nuclear Safety Code (NSC) the investigation report of the reportable event shall be submitted to the nuclear authority within 45 days.



In 2020, the report on an investigation was submitted to the authorities only 12 days after the 45-day deadline.

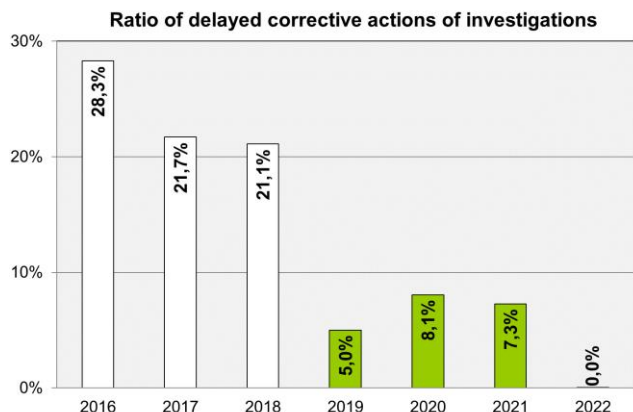
C.II.2.4 Ratio of delayed reportable investigations



In 2022 investigation of all 4 reportable events was completed by the specified deadlines.

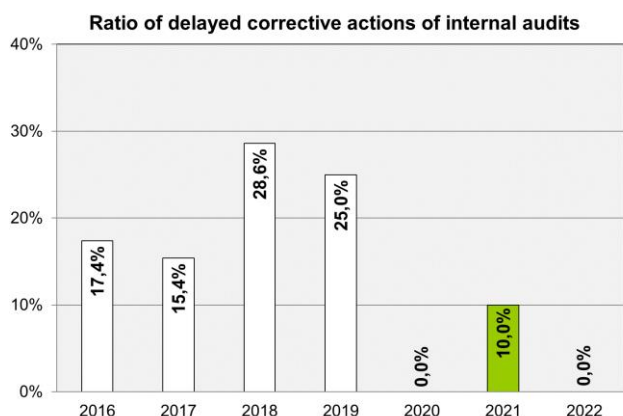
C.II.3 The effectiveness of corrective actions

C.II.3.1 Ratio of delayed corrective actions of investigations



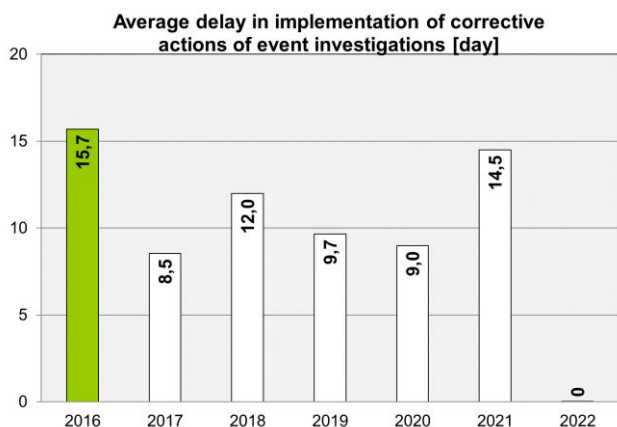
Before 2019 the indicator value was about 20%, however, last four years it improved significantly.

C.II.3.2 Ratio of delayed corrective actions of internal audits



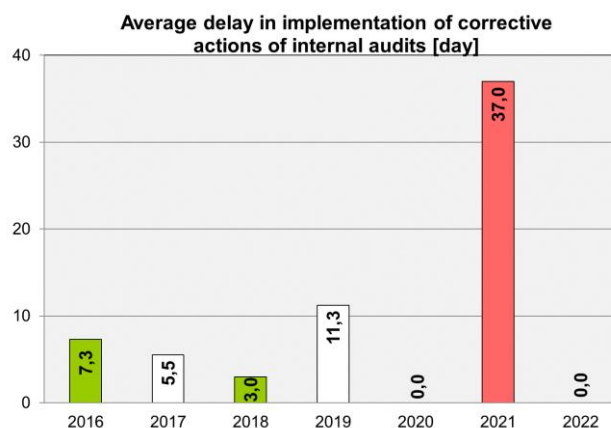
In most of the years the indicator was between 10-30%, but in the last three years it has decreased significantly.

C.II.3.3 Average delay in implementation of corrective actions of event investigations



Since 2013 the average delay in implementation of corrective actions of event investigations has the acceptable value. In 2017 the target values become more stringent, thus during the last five years before 2022 the indicator is qualified as corresponding to the operational requirements. No delays occurred in 2022.

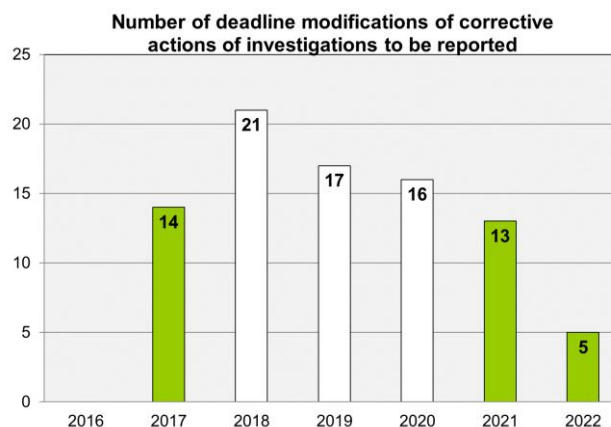
C.II.3.4 Average delay in implementation of corrective actions of internal audits



The average value of the delays remained acceptable in most years. In 2017 the target values become more stringent. In 2021 one task was delayed by 37 days.

C.II.3.5 Number of deadline modifications of corrective actions of investigations to be reported

In justified cases it is possible to request the modification of the deadlines established for the performance of corrective actions. However, the number of deadline modifications should be maintained at the reasonable level.



This indicator was introduced into the system in 2017. Its value has gradually improved over the last four years.

SUMMARY

The safety indicators are summarized in an up-to-date structure developed on the basis of international recommendations and used for evaluations during previous years. This system contains also information for safety related events. The WANO indicators suitable also for international comparison are evaluated separately.

Based on the collected information it can be declared that the four units of Paks NPP operated principally in accordance with the requirements of the Limited Condition of Operation also in 2022. The reactor core was continuously monitored. The normal process systems were operated and maintained in accordance with the requirements, the level of safety was acceptable. In 2022 the indicator demonstrating the general safety condition of the plant units on nominal power, the core damage frequency relating to internal technological initiating events and internal hazards, in accordance with analyses, was between $9,83 \cdot 10^{-6}$ – $1,3 \cdot 10^{-5}$ 1/year.

In 2022 there was no leaking fuel at Units 1,2 and 3. Measurements conducted at Unit 4 during the year gave indications to the presence of small leakages. In 2022 there was no primary leakage at Units, and the leakage indicator of the containment was also acceptable.

In general, the nuclear safety related engineering barriers were functioning well.

In 2022, the number of events reportable to the nuclear safety authorities and thus inspected on plant level was 4, which is lowest value of the total operational period so far.

Reactor scram in a critical state of the reactors did not occur in 2022.

The availability of the safety systems was maintained at a good level during the year.

The year 2022 was favourable in relation to radiation protection. The maximum individual radiation exposure was low (8.9 mSv), the value of the collective dose remained below the planned annual target value.

Radioactive discharges also remained below the regulatory limit, the nuclear power plant used 0.32% of the discharge limit in 2022. It can be concluded that the collective impact of the nuclear power plant and the Interim Spent Fuel Store to the environment in 2022 was negligible from radiation protection point of view.

As presented in the figures on pages 30 to 32, in 2022 the values of five indicators were falling into the (red) range requiring corrective action. The red indicators were specially investigated and corrective actions were taken by the competent professional organisation and approved by the Operation Review Committee of the power plant.

Plant operates smoothly
68

Operational performance 42	State of SSC 72	Events 99
Unplanned power losses 19	Radioactive waste 76	Reported events 100
Unit Capability Factor, % 89.87 % 46	Volume of low- and medium level liquid radioactive waste, m3 191.1 75	Number of events to be reported to the regulatory body 4 100
Forced Loss Rate, % 1.43 % 0	Volume of low- and medium level solid radioactive waste, m3 77 82	Number of significant events investigated internally 30 100
Unplanned power loss due to outage extension, % 1.01 % 19	Volume of high-level radioactive waste 0.51 72	Number of simplified investigations 45 83
Number of cases with unplanned power losses due to internal causes 25 20	Maintenance 71	Other significant events 95
	Ratio of maintenance rework, % 99.87 % 77	
	Ratio of performed and planned corrective work orders, % 97.12 % 86	
	Keeping deadlines for online work orders, % 98.26 % 89	
	Ratio of delayed failure corrections, % 20.63 % 0	
	Ratio of unsuccessful internal technical safety inspections, % 0.91 % 82	
	Material condition 95	
	Secondary side chemistry indicator 1 100 2 100 3 100 4 100	
	Equipment loading cycles accounting 1 0.758 87 2 0.617 91 3 1.007 79 4 0.6 92	
	Ratio of reserved tubes in SG 1 4.201 100 2 2.625 100 3 2.856 100 4 2.936 100	
	State of barriers 56	
	Fuel reliability, Bq/g 1 0.269 79 2 1.016 75 3 0.344 78 4 19.197 0	
	Number of Reactor Coolant System leakages 1 0 100 2 0 100 3 0 100 4 0 100	
	Confinement leakage, % 1 6.32 % 69 2 6.18 % 70 3 5.52 % 75 4 5.8 % 73	
	Dispersal iron in feedwater, ppb 1 3.855 100 2 3 100 3 3.713 100 4 3.547 100	

Operational Safety
84

Safety Systems and Equipment		Preparedness		Risk Management	
81		84		92	
Actuations	98	Operational staff	78	Plant configuration risk	90
Availability of Safety systems	65	Emergency	94	Initiating events	100
Reliability of starts	75	Operational staff	78	Number of registered entries in Limited Condition of Operation	172 / 66
Reliability of HPI pump starts	100 %	Ratio of failed licensing exams	1.1 % / 69	Number of violations of Limited Condition of Operation	0 / 100
Reliability of LPSI pump starts	99.74 % / 60	Ratio of failed company exams, %	2.33 % / 60	Conditional core damage probability caused by initiating events	0.00E+00 / 100
Reliability of CSS pump starts	100 % / 100	Number of trainings	3 / 100	Annual average core damage probability due to internal initiating events and internal hazards	1 9.83E-06 / 100 2 9.93E-06 / 100 3 1.04E-05 / 100 4 1.30E-05 / 92
Reliability of EFW and AFW pump starts	99.82 % / 66	Ratio of failed special company exams	0.42 % / 88	Time-averaged core damage frequency during full power operation due to internal initiating events calculated with the risk monitor, 1/year	1 4.12E-06 / 100 2 5.66E-06 / 75 3 3.52E-06 / 100 4 3.56E-06 / 100
Reliability of diesel starts	99.19 % / 63	Ratio of employees participating in emergency training, %	99.01 % / 70	Cumulative core damage probability during outage due to internal initiating events calculated with the risk monitor	1 1.43E-06 / 89 2 1.41E-06 / 89 3 7.05E-07 / 100 4 1.14E-06 / 96
Availability of Safety systems	65	Efficiency of corrective actions of Emergency drills, num	0 / 100		
Number of events causes unavailability of safety systems	14 / 57	Efficiency of corrective actions of Emergency drills, num	0 / 100		
Availability of High Pressure Safety Injection System	2.18E-03 / 32	Ratio of failed company exams, %	2.33 % / 60		
Availability of Low Pressure Safety Injection System	3.83E-04 / 61	Number of trainings	3 / 100		
Availability of Containment Spray System	1.67E-03 / 64	Ratio of failed special company exams	0.42 % / 88		
Availability of Auxiliary and Emergency Feedwater System	0.00E+00 / 100	Reliability of diesel starts	99.19 % / 63		
Availability of Dieselgenerators	1.22E-03 / 78	Reliability of EFW and AFW pump starts	99.82 % / 66		
Number of unplanned automatic reactor scrams	0 / 100	Reliability of HPI pump starts	100 % / 100		
Number of Emergency Core Coolant System actuations	0 / 100	Reliability of LPSI pump starts	99.74 % / 60		
Number of Emergency Electric Power Supply System actuations	0 / 100	Reliability of CSS pump starts	100 % / 100		
Number of reactor protection level 3 actuations	1 / 80	Reliability of EFW and AFW pump starts	99.82 % / 66		
Number of Auxiliary Feedwater System pumps actuations	0 / 100	Reliability of diesel starts	99.19 % / 63		

Published: MVM Paks Nuclear Power Plant Ltd.
Responsible: János Péter Horváth Chief Executive Officer
Cover Design: Bálint Vincze
Printed by: MVM Paks Nuclear Power Plant Ltd. 2023