



WANO

GLOBAL LEADERSHIP IN **NUCLEAR SAFETY**

PERFORMANCE INDICATORS

2017



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PERFORMANCE INDICATORS ENABLE COMPARISON

The WANO Performance Indicator Programme

supports the exchange of operating experience information by collecting, trending and disseminating nuclear plant performance data. WANO members across the globe submit data for a set of quantitative indicators of plant performance in the areas of nuclear plant safety and reliability and personnel safety. These indicators are intended principally for nuclear operating organisations to use as a management tool to monitor their performance and progress, to set their own challenging goals for improvement, and to gain additional perspective on their performance relative to that of other stations.

WANO continues to work closely with the International Atomic Energy Agency (IAEA) in the area of performance indicators. Crosschecking the data between the two organisations improves data quality and provides a better understanding of data reporting issues.

Besides the five key performance indicators that are discussed in this trifold, there are several more non-key indicators. Results can be found in the Quarterly reports and on the WANO website. For information, the definitions are as follows:

Unplanned Automatic (UA7) Scrams per 7,000 Hours Critical

This indicator is defined as the number of unplanned automatic scrams (reactor protection system logic actuations) that occur per 7,000 hours of critical operation (which is approximately one year of operation). It provides an indication of success in improving plant safety by reducing the number of undesirable and unplanned thermal-hydraulic and reactivity transients.

Fuel Reliability (FRI)

For this indicator, fuel reliability is inferred from fission product activities present in the reactor coolant. Due to design differences, this indicator is calculated differently for different reactor types. Overall, the purpose of this indicator is to monitor industry progress in achieving and maintaining high fuel integrity, and to foster a healthy respect for preservation of fuel integrity. Failed fuel represents a breach in the initial barrier preventing offsite release of fission products, has a detrimental effect on operating cost and performance, and increases the radiological hazard to plant workers.

Grid-Related Loss Factor (GRLF)

This is the percentage of maximum energy generation that a plant could not supply due to grid issues not under station management control.

Unplanned Capability Loss Factor (UCLF)

This is the percentage of maximum energy generation that a plant is not capable of supplying to the electrical grid because of unplanned energy losses (such as unplanned shutdowns or outage extensions) which are not under management control. A low value indicates important unit equipment is well maintained and reliably operated and there are few outage extensions.

Chemistry Performance (CPI)

The purpose of this indicator is to monitor operational chemistry control effectiveness. It combines several key chemistry parameters into a single indicator that can be used as an overview of the relative effectiveness of plant operational chemistry control.

Industrial Safety Accident Rate (ISA)

This indicator measures the number of accidents among employees that result in lost work time, restricted work, or fatalities per 200,000 (or 1,000,000) hours worked.

Unit Capability Factor (UCF)

This is the percentage of maximum energy generation that a unit is capable of supplying to the electrical grid, limited only by factors within the control of station management. A high unit capability factor indicates effective station programmes and practices to minimise unplanned energy losses and to optimise planned outages.

Contractor Industrial Safety Accident Rate (CISA)

This indicator measures the number of accidents among contractors that result in lost work time, restricted work, or fatalities per 200,000 (or 1,000,000) hours worked.

New Long-Term Objectives for 2020

In 2007, the WANO Governing Board approved the establishment of worldwide targets for key performance indicators that were to be achieved by 2015. In developing the targets, the WANO regional directors selected four performance indicators to monitor: forced loss rate (FLR), collective radiation exposure (CRE), industrial safety accident rate (ISA), and safety system performance indicator (SSPI).

For each performance indicator, two targets were established – industry-level targets and individual unit or station targets. As can be seen below, the industry targets are aimed at improving overall industry performance, and are based on 75% of the industry achieving the median values from the previous target period. Individual performance targets, on the other hand, are based on all units (100%) achieving results that are better than the lowest quartile values from the previous target period.

Based on a review of progress toward the 2015 long-term targets, new long-term targets for 2020 were proposed by the Performance Indicator programme and approved by the WANO Executive Leadership Team. In addition, a fifth key performance indicator was added – unplanned total scrams per 7,000 hours critical (US7) indicator – and individual and industry targets for 2020 were established based on historical performance by reactor type. Tracking the long-term targets for 2020 began in the first quarter of 2016.

INDICATOR	UNIT	INDIVIDUAL TARGET	INDUSTRY TARGET
Operating Period Forced Loss Rate (FLR)	Percent (%)	5.0	2.0
Collective Radiation Exposure (CRE)	Man-rem/yr Man-Sv/yr	AGR: 10/0.10 BWR: 180/1.80 LWCGR: 320/3.20 PHWR: 200/2.00 PWR: 90/0.90	AGR: 5.0/0.05 BWR: 125/1.25 LWCGR: 240/2.40 PHWR: 115/1.15 PWR: 70/0.70
Total Industry Safety Accident Rate (TISA)	Number per 200,000 hours worked	0.50	0.20
Safety System Performance Indicator (SSPI)	Unavailability	SP1 and SP2: 0.020 SP5 (EAC): 0.025	100% of worldwide units achieve the individual targets
Unplanned Total Scrams per 7,000 hours critical (US7)	Rate	BWR, PWR, LWCGR: 1.0 PHWR: 1.5 AGR: 2.0	BWR, PWR, LWCGR: 0.5 PHWR: 1.0 AGR: 1.0

Most of the long-term targets for 2020 are the same as those for 2015, with the following exceptions:

- Collective radiation exposure targets for advanced gas-cooled reactors (AGRs) have been updated due to changes in operational plant conditions.
- Personnel safety performance will be compared to targets for the new total industry safety accident (TISA) rate indicator, which replaces the ISA indicator used for the 2015 targets.
- The SSPI industry objective is now based on the percentage of units achieving all the individual SSPI targets.

The 2020 long-term objectives for FLR, CRE and TISA indicators are continued from 2015:

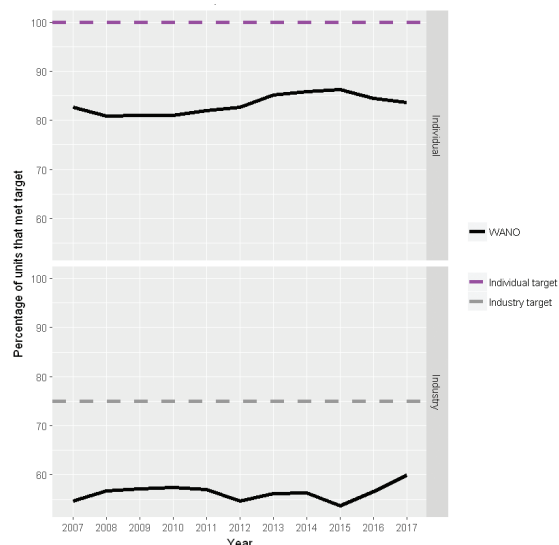
- As an industry: 75% of units shall have an indicator value better than achieved by 50% of units in 2007.
- Individually: 100% of units shall have an indicator value better than achieved by 75% of units in 2007.

The numerical target values corresponding to these objectives are summarised in the table above.

Forced Loss Rate (FLR)

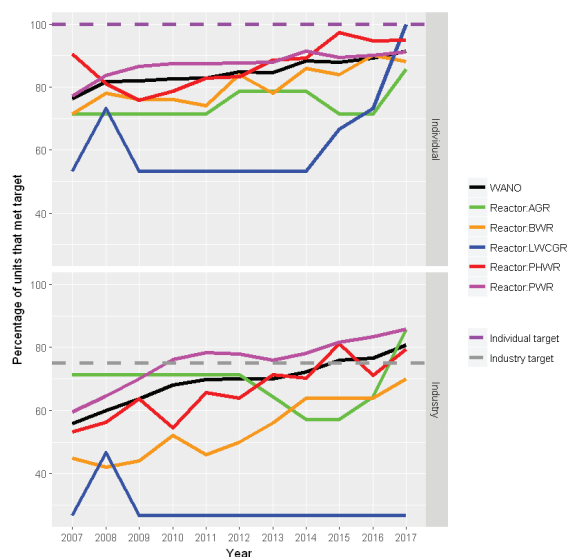
This indicator is the ratio of all unplanned forced energy losses to the reference energy generation minus energy generation losses corresponding to planned outages and any unplanned outage extensions during a given period of time, expressed as a percentage.

Unplanned energy losses are either unplanned forced energy losses or unplanned outage extensions of planned outage energy losses. Planned energy losses are those corresponding to outages or power reductions which were planned and scheduled at least four weeks in advance.



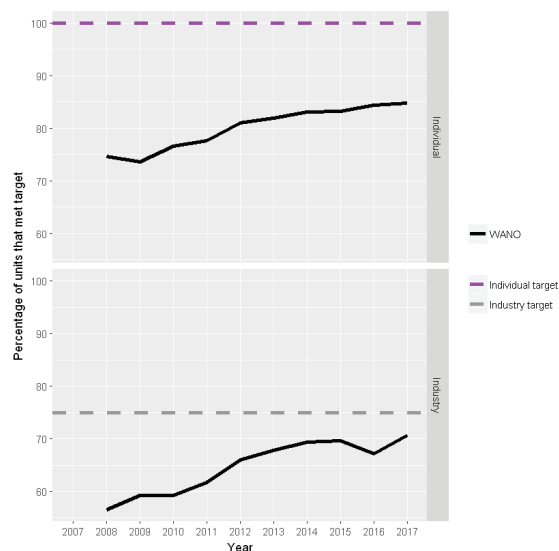
Collective Radiation Exposure (CRE)

This indicator is the total external and internal whole body exposure determined by primary dosimeter, and internal exposure calculations. It includes all measured exposure reported for station personnel, contractors, and personnel visiting the site or station on official utility business.



Total Industrial Safety Accident (TISA)

This indicator is the number of accidents for all plant personnel, including all staff, contractors, supplemental personnel, and all other non-utility personnel working onsite that result in one or more days away from work (excluding the day of the accident) or fatalities per 200,000 (TISA2) or per 1,000,000 (TISA1) hours worked.

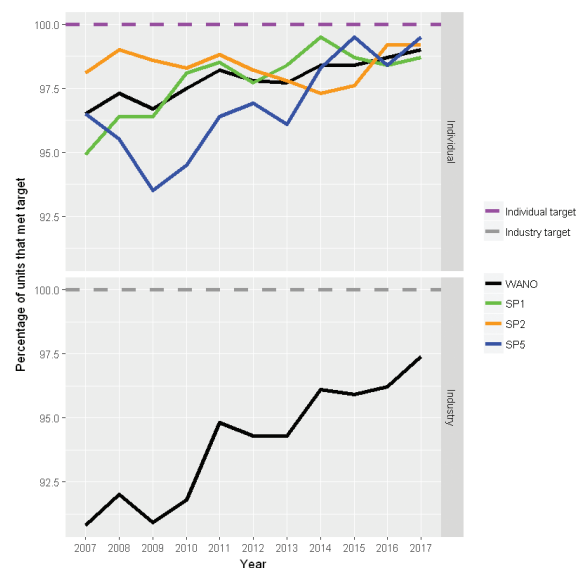


Safety System Performance Indicator (SSPI)

This indicator monitors the readiness of important safety systems to perform certain functions in response to off-normal events or accidents. It also indirectly monitors the effectiveness of operations and maintenance practices in managing the unavailability of safety system components. A low value for the safety system performance indicator indicates a greater margin of safety for preventing reactor core damage.

The SP1, SP2 and SP5 headings identify the specific safety systems monitored by the indicator. SP1 usually refers to the high pressure safety injection system and SP2 is usually the auxiliary feedwater system or other similar system. SP5 refers to the emergency power system. Other systems monitored vary according to reactor type.

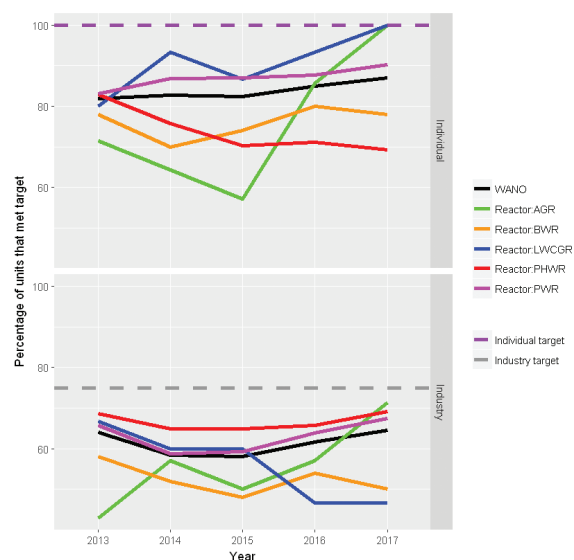
NOTE: Given the SSPI industry target definition for SSPI, the lower graph shows the percentage of units that have met all the individual targets for the different safety systems (SP1, SP2 and SP5). For this percentage, the industry objective is 100%.



Unplanned Total Scrams per 7,000 hours critical (US7)

This indicator is the sum of the number of unplanned automatic scrams (reactor protection system logic actuations) and unplanned manual scrams for approximately one year (7,000 hours) of operation.

Full worldwide data collection for the US7 indicator did not begin until 2013.



REACTOR TYPES

- AGR: Advanced gas-cooled reactor
- BWR: Boiling water reactor
- LWCGR: Light water cooled graphite-moderated reactor
- PHWR: Pressurised heavy water reactor
- PWR: Pressurised water reactor

NOTE

- * Historical data is presented based on current targets. Three-year values used for targeting.
- * Charts are based on Performance Indicator results obtained on 20 June 2018 and do not include long-term shutdown units.

WANO MISSION

TO MAXIMISE THE SAFETY AND RELIABILITY OF NUCLEAR POWER PLANTS WORLDWIDE BY WORKING TOGETHER TO ASSESS, BENCHMARK AND IMPROVE PERFORMANCE THROUGH MUTUAL SUPPORT, EXCHANGE OF INFORMATION AND EMULATION OF BEST PRACTICES.



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