

WORLD ASSOCIATION OF NUCLEAR OPERATORS

# Performance Indicators



2015

# WANO Vision: WANO and its members will be...

Among its continuing efforts to improve worldwide nuclear safety performance, WANO has announced long-term performance targets for selected performance indicators. The targets for forced loss rate, collective radiation exposure, individual safety accident rate and safety system performance were established for individual stations or units, and for the overall industry. The values were selected to be challenging and achievable by the end of 2015. The table below indicates the percentage of stations or units achieving those targets.

## LONG-TERM TARGET PERFORMANCE TABLES

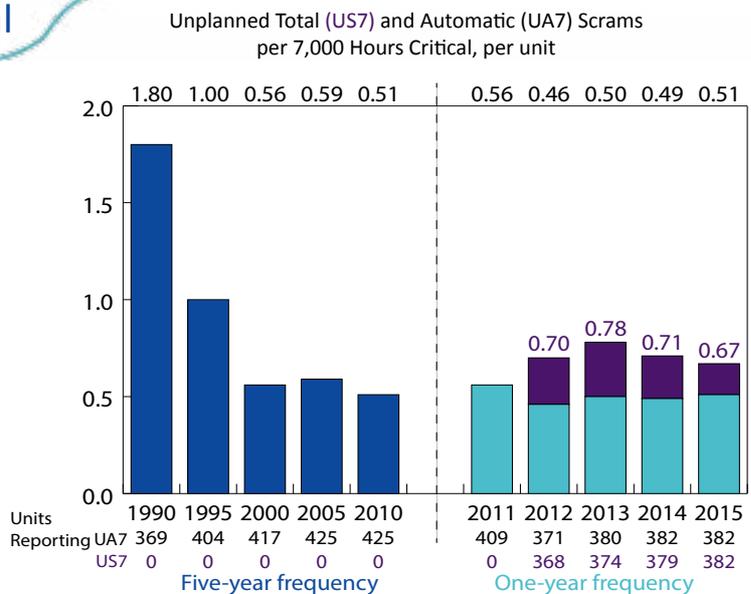
Results through 2015 Q4

Worldwide Status			
Key Indicator (Reactor types combined for applicable indicators)	Percentage of Stations/Units Achieving Individual Target (Objective: 100%)	Percentage of Stations/Units Achieving Higher than 2007 Median Values (Objective: 75%)	Percentage of Station/Unit Safety Systems Demonstrating Indicator Stability or Improvement (Objective: 100%)
Collective Radiation Exposure (CRE)	87.7%	75.3%	
Forced Loss Rate (FLR)	85.6%	52.9%	
Industrial Safety Accident Rate (ISA)	85.3%	75.9%	
Safety System Performance (SSPI)	98.5%		65.2%

## Unplanned Total (US7) and Automatic (UA7) Scrams per 7,000 Hours Critical

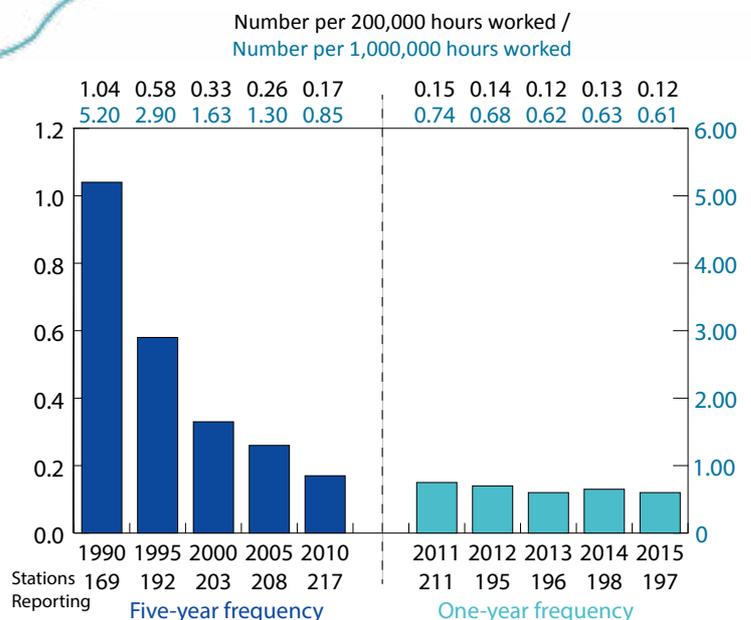
The unplanned scrams per 7,000 hours critical indicator tracks the mean scram (shutdown) rate for approximately one year (7,000 hours) of operation. Unplanned scrams result in thermal-hydraulic and reactivity transients that require automatic or manual reactor scrams and affect plant systems. (See Note 1.)

US7 data collection began in 2012 and from this point UA7 (light blue) is displayed as a part of US7 (unplanned total scrams).



## Industrial Safety Accident Rate (ISA)

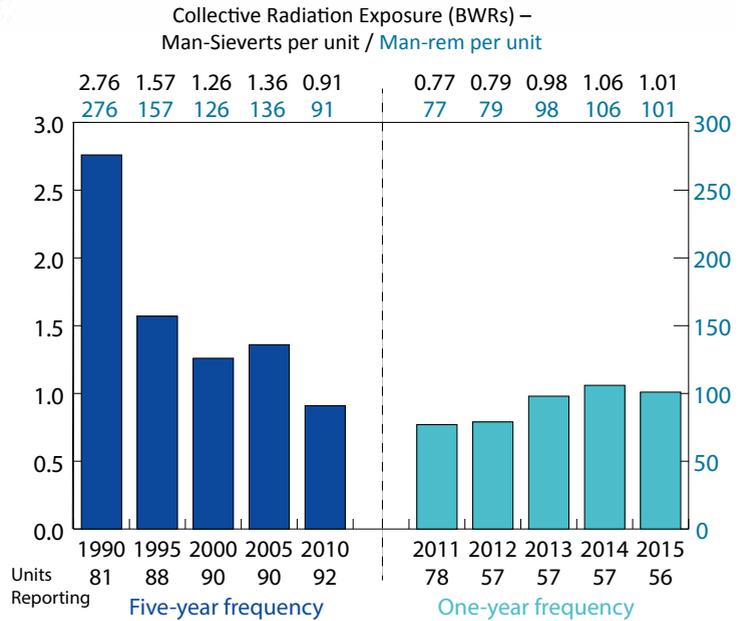
The industrial safety accident rate tracks the number of accidents among employees that result in lost work time, restricted work, or fatalities per 200,000 hours worked (and 1,000,000 hours worked). The nuclear industry continues to provide one of the safest industrial work environments.



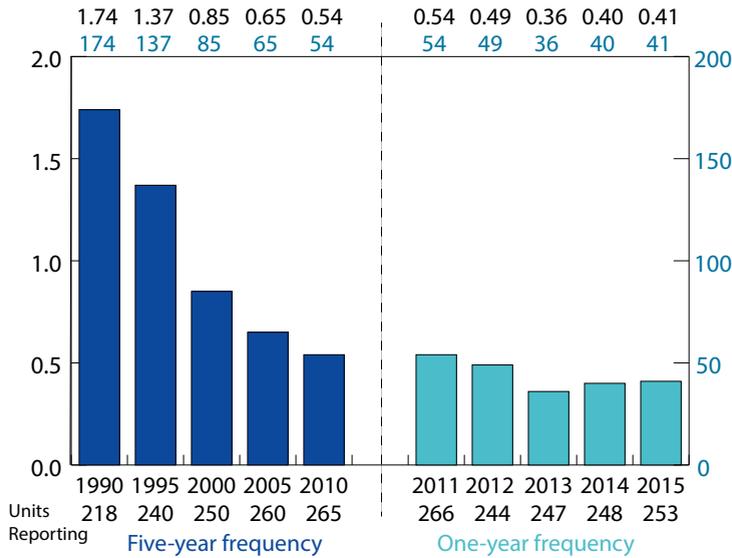
# ...worldwide leaders in pursuing excellence in operational...

## Collective Radiation Exposure (CRE)

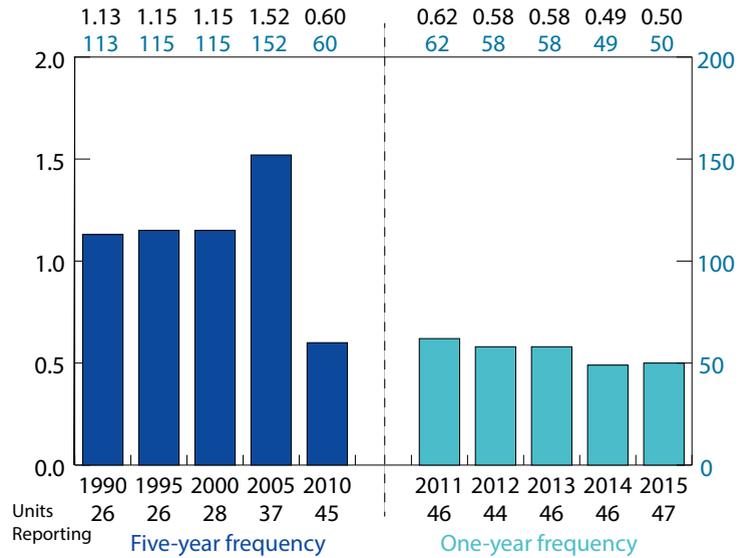
The collective radiation exposure indicator monitors the effectiveness of personnel radiation exposure controls for boiling water reactors (BWRs), pressurised water reactors (PWRs), pressurised heavy water reactors (PHWRs), light-water-cooled graphite reactors (LWCGRs), and gas-cooled reactors (AGRs and GCRs). Low exposure indicates strong management attention to radiological protection.



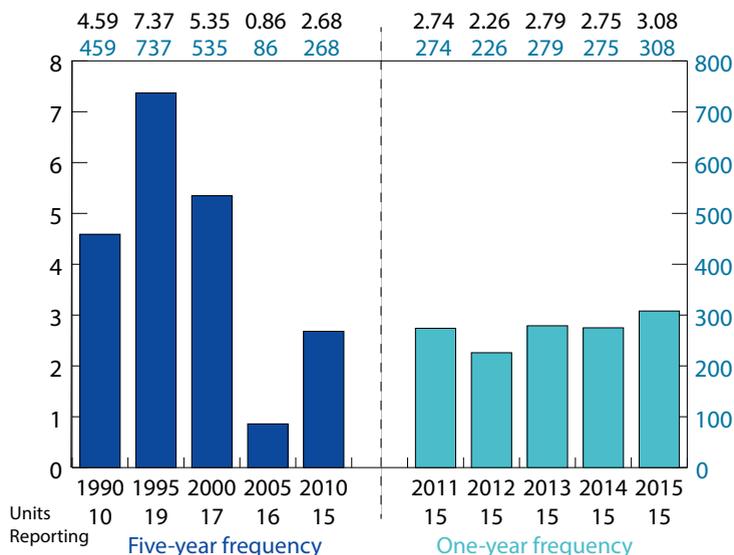
Collective Radiation Exposure (PWRs) –  
Man-Sieverts per unit / Man-rem per unit



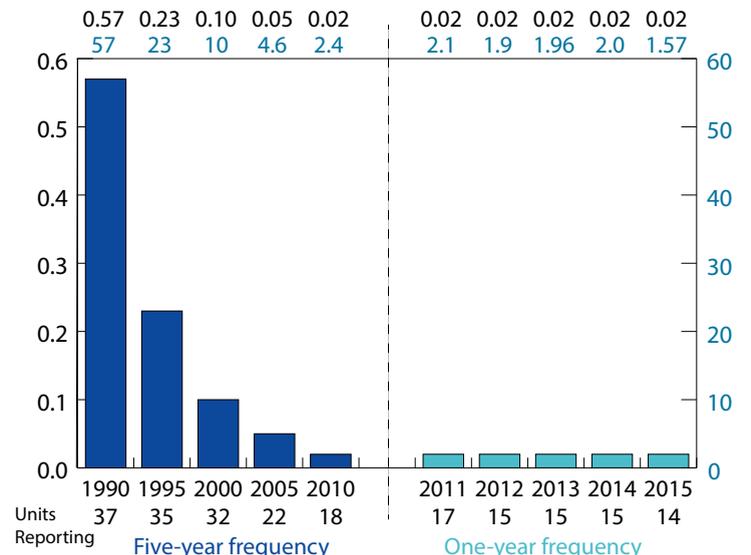
Collective Radiation Exposure (PHWRs) –  
Man-Sieverts per unit / Man-rem per unit



Collective Radiation Exposure (LWCGRs) –  
Man-Sieverts per unit / Man-rem per unit



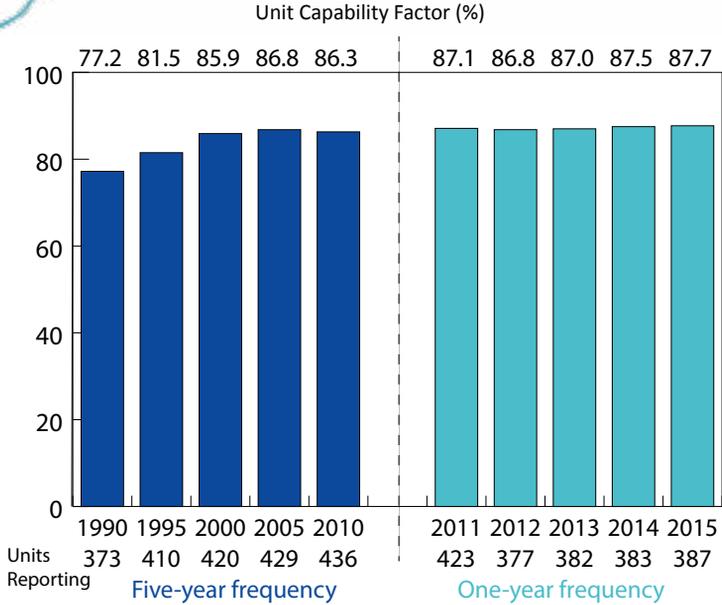
Collective Radiation Exposure (AGRs & GCRs) –  
Man-Sieverts per unit / Man-rem per unit



# ...nuclear safety for commercial nuclear power.

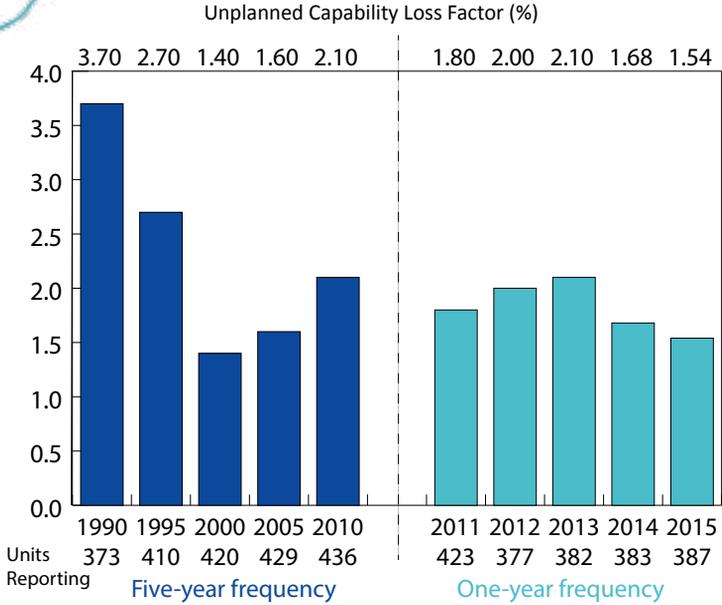
## Unit Capability Factor (UCF)

Unit capability factor 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.



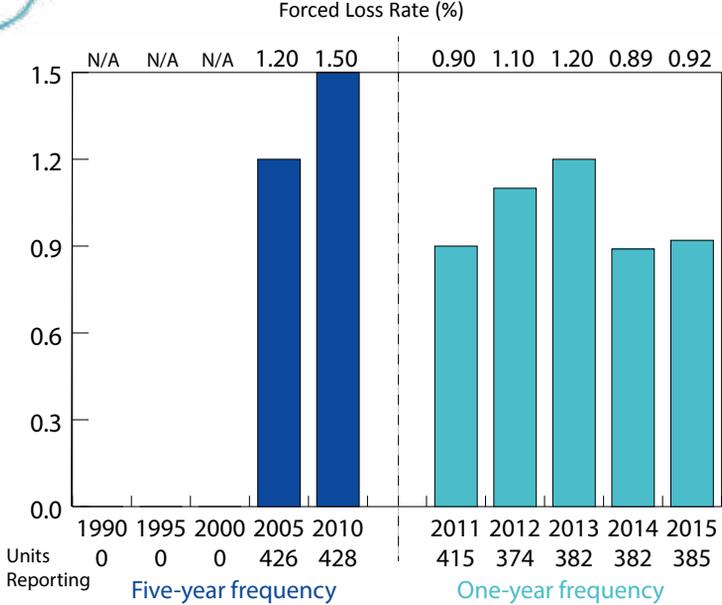
## Unplanned Capability Loss Factor (UCLF)

The unplanned capability loss factor is the percentage of maximum energy generation that a unit is not capable of supplying to the electrical grid because of unplanned energy losses, such as unplanned shutdowns or outage extensions. A low value indicates important unit equipment is well maintained and reliably operated and there are few outage extensions.



## Forced Loss Rate (FLR)

The forced loss rate is the percentage of energy generation during non-outage periods that a unit is not capable of supplying to the electrical grid because of unplanned energy losses, such as unplanned shutdown or load reductions. A low value indicates important unit equipment is well maintained and reliably operated. (See Note 3.)



WANO monitors five additional performance indicators: safety system performance, chemistry performance, fuel reliability, grid-related loss factor and contractor industrial safety accident rate. The first three indicators are defined in a manner that reflects differences in plant-specific designs, configurations, or operational practices. As a result, data for these three indicators cannot be summarised across reactor types for inclusion in this report. Additionally, grid-related loss factor is out of station management control. These indicators are available to WANO members in more detailed reports on the WANO member website.

### Safety System Performance (SSPI)

The safety system performance indicator monitors the availability of three important standby safety systems at each plant. Safety systems that are maintained in a high state of readiness have a high probability of being capable of mitigating off-normal events.

### Chemistry Performance (CPI)

The chemistry performance indicator provides an indication of progress in controlling chemical parameters to retard deterioration of key station materials and components. These parameters are to be maintained within strict guidance developed by the industry.

### Fuel Reliability (FRI)

The fuel reliability indicator monitors progress in preventing defects in the metal cladding that surrounds fuel. Maintenance of fuel cladding integrity reduces radiological impact on station operations and maintenance activities.

### Grid-Related Loss Factor (GRLF)

The grid-related loss factor is the percentage of maximum energy generation that a plant could not supply due to grid issues not under station management control.

### Contractor Industrial Safety Accident Rate (CISA)

The contractor industrial safety accident rate tracks the number of accidents among contractors that result in lost work time, restricted work, or fatalities per 200,000 work-hours (and 1,000,000 hours worked).

The WANO Performance Indicator Programme supports the exchange of operating experience information by collecting, trending and disseminating nuclear plant performance data in 12 key areas. The data is gathered for a set of quantitative indicators of plant performance. These indicators are intended principally for use as a management tool by nuclear operating organisations to monitor their own performance and progress, to set their own challenging goals for improvement, and to gain additional perspective on performance relative to that of other stations.

It is now widely recognised that a good set of overall performance indicators can provide a partial, but important and useful, measure of how well a nuclear station is managed overall.

WANO published and distributed the first performance indicator report in April 1991. In 1993, reporting of data began for all reactor designs.

It is expected that the use of WANO performance indicators will encourage emulation of the best industry performance. It should also further motivate the identification and exchange of good practices in nuclear plant operations.

#### Notes:

- 1. The median values are displayed for all indicators except unplanned scrams per 7,000 hours critical (US7 and UA7), where the mean values are shown, and industrial safety accident (ISA) rate, which is an overall industry value.*
- 2. Half of the values are above and half are below the displayed median values. The mean is the arithmetical average of the values. The median value is normally displayed rather than the mean value because the median value is less susceptible to influence of outliers and is therefore more representative of overall performance.*
- 3. Worldwide collection of data needed to calculate the forced loss rate (FLR) indicator did not begin until 2001.*
- 4. Charts are based on performance indicator results obtained 7 March 2016.*



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## **Our 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.***