November 2018 Version

KPI WANO Working Group: Subgroup "Conservative Decisions"

Industry decision making paper "WANO KPIs should give credit to conservative decisions"

Purpose

The current WANO PI reference manual does not differentiate between a forced loss induced by a lack of maintenance or by a conservative decision. Both have the same impact on existing indicators (UCF, FLR & UCLF). The purpose of this proposal is to correct this discrepancy.

Executive summary with the recommendation (including benefits)

Conservative decisions to lower power or to shut down a unit based on potential equipment conditions gleaned from operating experience or discovered technical safety concerns (not actual unit equipment performance) are currently counted as planned or unplanned energy losses against the FLR, UCLF and UCF indicators even if the suspected condition is found nonexistent.

The WANO KPI Working Group recommends an exemption to reporting energy loss as result of a conservative decision as defined in this paper. Such an exemption would apply in the same way as for energy losses that are not under management control.

This recommendation is in line with WANO's principle to give credit for conservative decisions and to support safe operation of nuclear power plants. It is inspired by the "PI background admonition".

November 2018 Version

The decision to exempt conservative decision-making from the reporting of nuclear power plant (NPP) energy losses takes into consideration the following risks, impacts & mitigation measures.

NO CHANGE RISK MATRIX		
Risk	**Impact**	**Mitigation Measure**
Misleading comparison of performance between plants.	Potentially eroding WANO PI credibility	Conservative decisions proposal
Existence of invalid trends continue	Misleading picture of the industry performance	Conservative decisions proposal
Create discrepancy between internal and external benchmark of NPP	Potentially diminishing WANO PI added-value	Conservative decisions proposal

CHANGE RISK MATRIX		
Risk	**Impact**	**Mitigation Measure**
Create discrepancy with IAEA reference manual	Potentially eroding WANO PI credibility	Include IAEA in discussions (initiated in April 2017).
Create discontinuity in indicators	Trending and comparison with historical performance could be affected	Cannot be mitigated, the group is not proposing to back fit historical data due to complexity.
Invalid use in the use of Conservative Decisions	Artificially bettering existing indicators	The NPP is responsible for notifying WANO of the use of the conservative decision exemption by utilizing the comments in the WANO PI database. WANO Centers can ask the NPP to justify the use of the conservative decisions exemption. WANO Centers will reject invalid use of the exemption.

November 2018 Version

Proposal

Definition

Conservative decision[1] exemptions are energy losses which meet ALL of the listed criteria below. They are outages and power reduction losses that:

1. ARE used to investigate / analyse potential technical safety concerns regarding the design or fabrication of the plant,
2. ARE based upon operating experience or discovered technical safety concerns,
3. ARE NOT leading to plant design modification or repair (except for unplanned plant design modifications to comply with new safety standards),
4. ARE NOT forced by equipment failure that could have been prevented by maintenance,
5. ARE NOT forced by human error.

Principles

WANO / IAEA KPI reporters will maintain open lines of communication with their respective WANO / IAEA KPI Center Coordinators and report quarterly any conservative decision making exemptions and the associated energy loss amount within the energy loss comment fields, allowing the WANO KPI Center Coordinator to discuss the use and the volume claimed under the exemption.

[1] A conservative decision to take action that has been made by plant management. It can also include decisions taken by a regulatory body that fall within the definition listed above.

Example 1

Description

A plant was informed about bolt cracking at another plant through operating experience and has the same turbine. The plant management decides to conservatively shut down the plant to inspect the bolts without waiting for the future outage. Inspections demonstrated there were no issues in this plant.

Criteria

	CRITERIA	JUSTIFICATION
1	ARE used to investigate/analyse potential safety concerns regarding the design/fabrication of the plant	Plant management decided to investigate the bolts. There was no evidence that the same issue existed, only that the same bolts were used
2	ARE based upon operating experience or discovered technical safety concerns NPP)	The information about cracked bolts came from external operating experience
3	ARE NOT leading to plant design modification or repair (except for unplanned plant design modifications to comply with new safety standards)	Inspections demonstrated there were no modifications or repair required to restart the plant
4	ARE NOT forced by equipment failure that could have been prevented by preventative or predictive maintenance	Inspections demonstrated there were no issues in this plant.
5	ARE NOT forced by human error	There was no human error forcing the stop

Without Conservative Decision Proposal

Under the current rules, this conservative decision will impact FLR if it is not planned 28 days in advanced. The decision to take action, implement OPEX, and ensure safe operation would be impacted even though the outcome revealed no modification or repair were required.

With Conservative Decision Proposal

There is no penalty under FLR.

Example 2

Description

A regulator asks a plant to prolong an outage because the regulator believes there could be a potential safety issue that needs further investigations. The plant management does not agree with the regulator but is forced to prolong the outage in order to investigate the potential safety issue as requested by the regulator. After these investigations, the unit was allowed to restart without any modifications or repairs.

Criteria

	CRITERIA	JUSTIFICATION
1	ARE used to investigate/analyse potential safety concerns regarding the design/fabrication of the plant	Regulator asks to prolong the outage to allow extra investigations. There was no evidence that the issue actually existed, there was only a potential safety issue.
2	ARE based upon operating experience or discovered technical safety concerns NPP)	Discovered technical safety concerns (potential)
3	ARE NOT leading to plant design modification or repair (except for unplanned plant design modifications to comply with new safety standards)	Inspections demonstrated there was no need for modifications or repair in order to restart the plant
4	ARE NOT forced by equipment failure that could have been prevented by preventative or predictive maintenance	Inspections demonstrated there were no issues in this plant.
5	ARE NOT forced by human error	There was no human error forcing the stop

Without Conservative Decision Proposal

This would negatively impact that station who was in a planned outage under WANO's current guidance.

With Conservative Decision Proposal

This would not negatively impact that station.

Example 3

Description

During outages, hydrogen flakes were detected in two reactor vessels, fabricated by the same vendor that went bankrupt several years before. The vendor had fabricated and delivered reactor vessels for several plants in the world. The plant management decided to prolong the outages in order to check the safety case. The regulator allowed a conditional restart of the units after several months. There was no need for any hardware modification or repair, but the regulator asked the plants to perform some extra tests in a research reactor to check some assumptions that were used in the safety case. As the first test results led to some doubts, plant management decided to stop both units immediately once more. Several months later, the regulator was convinced of the robustness of the safety case and allowed restart of the units

Criteria

	CRITERIA	JUSTIFICATION
1	ARE used to investigate/analyse potential safety concerns regarding the design/fabrication of the plant	Plant management decided twice to investigate the reactor vessels and to conduct extra tests in external research reactors. The bankrupt reactor vessel vendor was not able to provide extra or more fabrication details. In the end, it was confirmed that the hydrogen flakes were present in the reactor vessel since the beginning and there was no real safety issue.
2	ARE based upon operating experience or discovered technical safety concerns NPP)	The hydrogen flakes were first detected in one unit. Another unit did similar investigations based on this operating experience and came to the same conclusions
3	ARE NOT leading to plant design modification or repair (except for unplanned plant design modifications to comply with new safety standards)	There were no modifications or repairs required to restart the units. The safety case studies confirmed the units could safely restart
4	ARE NOT forced by equipment failure that could have been prevented by preventative or predictive maintenance	No preventative or predictive maintenance could have avoided the hydrogen flakes, as they were present since the fabrication
5	ARE NOT forced by human error	There was no human error forcing the stops

Without Conservative Decision Proposal

The Unit capability loss factor (UCLF) and the unit capability factor (UCF) are impacted as result of the first outage extension. Forced Loss rate (FLR) and UCF are impacted as result of the second stop

With Conservative Decision Proposal

This would not negatively impact that station.

Example 4

Description

Reportable Ultrasonic testing (UT) indications were detected in the base material of the reactor pressure vessel of Unit 1 during scheduled in-service inspections. Standard operating procedure in plants with a highly developed safety culture mandates such UT results be assessed prior to continued service of the plant. Therefore, the plant underwent extensive tests and inspections. There was no need for any hardware modification or repair. Finally, the operator demonstrated beyond any doubt that the plant was safe for continued service, and the regulator accepted the safety case, allowing the unit to restart. As a consequence, the outage duration was approximately three years.

Criteria

	CRITERIA	JUSTIFICATION
1	ARE used to investigate/analyze potential safety concerns regarding the design/fabrication of the plant	The extensive safety case confirmed that the aluminum oxide inclusions were present in the reactor vessel since fabrication, and there was no related safety issue.
2	ARE based upon operating experience or discovered technical safety concerns NPP)	The indications were detected by ultrasonic testing during a regular outage of the unit.
3	ARE NOT leading to plant design modification or repair (except for unplanned plant design modifications to comply with new safety standards)	There were no plant design modifications or repairs required to restart the unit. The safety case, accepted by the regulator, confirmed that the unit was safe restart.
4	ARE NOT forced by equipment failure that could have been prevented by preventative or predictive maintenance	No maintenance could have avoided the indications of aluminum oxide inclusions, as they were present since the fabrication of the pressure vessel.
5	ARE NOT forced by human error	There were no contributions of human errors whatsoever.

Without Conservative Decision Proposal

The Unit capability loss factor (UCLF), the unit capability factor (UCF) and the forced loss rate (FLR) are impacted as result of the outage extension.

With Conservative Decision Proposal

This would not negatively impact that station.

November 2018 Version

Impact calculation

Impact calculation is based upon the KPI (UCF, UCLF, FLR) international average (IAEA figures), considering that 10% of the fleet is impacted by CD (Conservative Decisions).
For 10 Unit Fleet, we decompose the fleet in 9 units (not impacted by CD) and 1 unit (impacted by CD), in order to get the average impact on the 10 units.

10 Unit Fleet example

Units concerned	Annual KPI	UCF	FLR	UCLF
90% (9 on 10)	without CD loss	79%	3%	4%
10% (1 on 10)	with CD loss for the whole year	0%	100%	100%
100% (10 on 10)	Average **before** the proposal	71% (9*79%+1*0%)/10	13% (9*3%+1*100%)/10	14% (9*4%+1*100%)/10
100% (10 on 10)	Average **after** the proposal	81% (9*79%+1*100%)/10	3% (9*3%+1*0%)/10	4% (9*4%+1*0%)/10
	ACTUAL IMPACT (without CD)	-10,0%	+10%	+10%

50 Unit Fleet example

Units concerned	Annual KPI	UCF	FLR	UCLF
90% (45 on 50)	without CD loss	79%	3%	4%
8% (4 on 50)	with CD loss for a quarter of a year	59% *(0*0,25+79*0,75)*	27% *(100*0,25+3*0,75)*	28% (100*0,25+4*0,75)*
2% (1 on 50)	with CD loss for the whole year	0%	100%	100%
100% (50 on 50)	Average **before** the proposal	76% (45*79%+4*59%+1*0%)/50	7% (45*3%+4*27%+1*100%)/50	8% (45*4%+4*28%+1*100%)/50
100% (50 on 50)	Average **after** the proposal	80% (45*79%+4*84%+1*100%)/50	4% (45*3%+4*2%+1*0%)/50	4% (45*4%+4*3%+1*0%)/50
	ACTUAL IMPACT (without CD)	-4%	+4%	+4%

Ex 1: For a 10 Unit fleet, actual UCF is 71% (when 1 plant is facing CD without the proposal), instead of 81% (if the plant is facing CD but with the proposal). Actual impact of having no proposal is -10% on UCF.
*Ex 2: for a 50 Unit fleet, actual FLR is 7% (with 45 units at 3%, 4 units at 27% and 1 unit at 100%), instead of 4% (with 45 units at 3%, 4 units at 2% (0*0,25+3*0,75) and 1 unit at 0%). Actual impact of having no proposal is +4% on FLR.*

November 2018 Version

November 2018 Version

Appendix: proposed changes to the WANO PI manual

In red: the additions to the current manual

Unplanned energy losses resulting from the following conditions are considered to be under the control of plant management:

- Unplanned maintenance outages, excluding extensions of planned outages. (Extensions of planned outages are always reported as unplanned outage extension energy losses if the extension was planned and scheduled less than four weeks before the extension began or the originally scheduled work was not being completed. If the extension was planned and scheduled at least four weeks before the extension began, the losses may be included as planned energy losses.)
- Unplanned outages or load reductions for unplanned testing, repair, or other plant equipment or personnel-related causes.
- Unplanned outages or load reductions that are caused or prolonged by regulatory actions taken as a result of plant equipment or personnel performance, or regulatory actions applied. This also applies on a general basis to all similar plants, excluding those associated with extensions of planned outages or due to conservative decisions (see further).

Unplanned energy losses due to the following causes are not reported because these losses are **not** considered to be under the control of the plant management:

- grid instability or failure
- lack of demand (reserve shutdown, economic shutdown, or load following)
- environmental limitations (e.g. low cooling pond level, water intake restrictions, earthquakes or deluges that could not be prevented by operator action)
- fuel
- seasonal variations in gross dependable capacity due to cooling water temperature variations
- fuel conservation directed by regulatory authority
- labour strike

If a labour strike occurs during plant operation, any outage or load reduction, generation losses due to the strike are not reportable. If the strike occurs during a planned and scheduled outage, the original scheduled end date of the planned outage is considered to have been extended by the duration of the strike. The revised scheduled end date is used to determine planned losses and outage extension losses once the strike is over. If the strike occurs during an unplanned/forced outage, reportable unplanned losses resume after the strike is over.

Unplanned energy losses due to the following causes are also not reported because these losses are considered conservative decision [1] exemptions

Outage time and Power reductions which meet all of the criteria below (conservative decision exemption):

1. ARE used to investigate / analyse potential safety concerns regarding the design or fabrication of the plant,
2. ARE based upon operating experience or discovered technical safety concerns,
3. ARE NOT leading to plant design modification **or repair** (except for unplanned plant design modifications to comply with new safety standards),
4. ARE NOT forced by equipment failure that could have been prevented by maintenance,
5. ARE NOT forced by human error.

It is the responsibility of the NPP to identify the use of conservative decision exemption in the comment section of the WANO PI database. WANO Centers can ask the NPP to justify the use of the conservative decisions exemption. WANO Centers will reject invalid use of the exemption.

[1] A conservative decision to take action that has been made by plant management. It can also include decisions taken by a regulatory body that fall within the definition listed above.

Impact on historical numbers

No changes of numbers in the past is proposed.

Technical Feasibility

Technical feasibility has been confirmed by WANO LO expert Volodymyr Turbayevsky.

Working group advice:

Subcommittee Members

Operators Representatives

Meaghan Boisvert & Danny Ip (**OPG**), Russell Brooks (**EDF Energy**), Jo Byttebier (**ENGIE**), Christophe Degouy (**EDF**), Alex Girouard (**NB Power**), Glen Masters (**INPO**), Fabiano Portugal (**Electronuclear**), Steffen Asser (**SwissNuclear**), Wenbiao Feng (**CGN Power CO**).

WANO Representatives

Françoise Broxolle & Roland Schoellhorn (**WANO PC**), Kris Mertens & Volodymyr Turbayevsky (**WANO LO**), Ian Oliver (**WANO PC**).

Voting Procedure

Among Subcommittee

Majority must be reached among subcommittee operators' representatives for the proposal to be considered accepted.
12 working group members out of 13 voted in favor of the proposal, 1 against, leading to its acceptance among working group members.

Among Working Group

To be defined.