Western European
WENRA RHWG
Nuclear Regulators Association

Report

WENRA Safety Reference Levels 2014 - Implementation at the nuclear power plants, reasonably practicable safety improvements and benchmarking - Pilot Study

A RHWG report
for the attention of WENRA
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Table of Contents

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01
Introduction and General Approach

In 2014 WENRA published the revised Safety Reference Levels (SRL) as a result of a review in the light of the learning from the TEPCO Fukushima Daiichi NPP accident. The first task for WENRA countries was to implement the new SRL into their national regulation. Afterwards WENRA's Reactor Harmonization Working Group (RHWG) started to discuss options for a benchmarking process on the implementation of SRL at the Nuclear Power Plants.

During its fall meeting 2017, WENRA advised that RHWG should combine the following tasks into a single task:

- Implementation of the 2014 RLs at the plants,
- Safety improvements for implementation of the VDNS.

This should look at the implementation of a subset of RLs at a representative sample of existing plants per country covering the range of reactor designs in WENRA countries. WENRA suggested that RHWG should review implementation of Issue F for plant faults with emphasis on severe accident management. The task should also look at:

- Implementation of NSD articles 8(a) to 8(c) – especially 8(a),
- Benchmarking on specific safety improvements.

Concerning the original task defined by WENRA, RHWG selected SRLs F4.8 to F4.18 as candidates. A RHWG subgroup was founded. Countries were asked to give feedback on the technical solutions (improvements) that are or will be installed in their NPPs for compliance with these SRLs. SRLs have been selected as ones that would provide the most fruitful insight, are linked to Articles 8a, are particularly associated with preventing early and large releases.

In January 2019 it was decided to conduct a pilot study with two SRLs to prove the chosen approach of RHWG to fulfil the task mentioned above. The following SRL were selected:

- F4.10 – The threats due to combustible gases should be managed.
- F4.17 – Adequate power supplies during DEC shall be ensured considering the necessary actions and the timeframes defined in the DEC analysis, taking into account external hazards.

The objectives of the pilot study are:

- to prove the chosen approach,
- to show the harmonization status in WENRA countries with regard to the selected SRL,
- to share information on different technical solutions to implement the SRLs at the NPPs and to learn from each other,
- to address the timeliness of the safety improvements,
- to present lessons learned.

On the basis of country feedbacks, lists of technical solutions were compiled for both SRLs. Various technical solutions have been given for each of the selected SRLs. These technical solutions may be needed altogether for SRL fulfilment, or may describe alternative ways to fulfil the SRL, or can be seen as supplementary measures. Depending on the SRL, the lists are different for the different reactor types to be considered in WENRA countries.

Nuclear power plants in WENRA observer countries are included in the exercise to the extent these countries wish to be.

It has to be pointed out, that when compiling the lists of technical solutions, the details of their design and the implementation status reflect the position of the corresponding national authority.

02
Country Input

Country input was compiled in SRL specific templates.

For F4.10 all countries have given input that is valid for all their NPPs, except Japan Information given for the Japanese PWRs is only valid for those plants that have got restart permission after the Fukushima accident.

For F4.17 most countries have given input that is valid for all their NPPs. However, some countries provided input for representative plants. In these cases, the pilot study does not evaluate the general implementation status in these countries.

03
Results with regard to the implementation status of the SRLs at the NPPs

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03.1 Benchmark results on technical solutions related to SRL F4.10

F4.10 – The threats due to combustible gases should be managed.

In all countries reasonably practicable technical solutions have been implemented at the NPPs to manage combustible gases in the containment (PARs in PWRs and CANDU type plants, N_2-inertisation respectively igniters and/or PARs in BWRs).

In AGR type plants flammability limits are not exceeded even under design extension conditions. Therefore, there is no need to discuss the implementation status of related technical solutions assigned to SRL F4.10.

The time interval of implementing these means covers periods of approximately 20 years or more (e.g. the PAR installation in PWRs). The aspect of timeliness of implementing reasonably practicable improvements is addressed in a separate paragraph.

In some PWRs, depending on the design of the inner containment compartment structures and the PAR efficiency/locating design concept, forced openings are foreseen to ensure sufficient containment atmosphere mixing. This concerns the KWU PWRs (in Germany, Spain, Switzerland and The Netherlands) and the design of the British PWR, as well as the Westinghouse ice-condenser containment at the WWER 440 in Finland.

In addition, in some PWRs, hydrogen igniters are installed for specific severe accident courses (e.g. rapid hydrogen release situations with locally high hydrogen concentrations). It may be of interest to promote a separate exercise to identify potential differences with regard to the safety significance (risk contribution) of severe accident courses that may need igniters in addition to a installed PAR concept for different PWR designs.

03.2 Benchmark results on technical solutions related to SRL F4.17

F4.17 – Adequate power supplies during DEC shall be ensured considering the necessary actions and the timeframes defined in the DEC analysis, taking into account external hazards.

In all countries reasonably practicable technical solutions have been implemented at the NPPs to ensure adequate power supplies during DEC including:

- the availability of diverse diesel generators on the site and

- a site autonomy of at least 72 hours.

For the other technical solutions discussed the following is concluded:

- "other diverse AC power supply sources, e.g. gas turbine plant" are seen as an additional option to enhance off-site power supply availability.
- "non-electricity driven systems" are considered as diverse mean to enhance availability of necessary key safety functions in case of a CCF in the AC power supply.
- "specific AC power supply for DEC B systems" are covered by the availability of diverse diesel generators on the site.

With regard to the availability of diverse diesel generators (DGs) on the site, all countries reported that such DGs have been installed or will be installed in 2019, in Hungary and Sweden the additional installation of large stationary DGs is planned after 2019. The DGs comprise stationary as well as mobile ones, except for Finland and the United Kingdom, where solely stationary DGs are on the site.

With regard to the 72-h site autonomy, all countries reported that a 72 h site autonomy is or will be implemented up to 2019, Hungary plans implementation after 2019.

The time interval of implementing the essential means for SRL F4.17 covers periods of approximately 25 years or more. The aspect of timeliness of implementing reasonably practicable improvements is addressed in a separate chapter.

SRL F4.17 also addresses ensured power supplies taking into account external hazards. In this Pilot Study, focus is put on natural external events more severe than the related design basis events.

All countries confirm the function of DGs in case of an external flooding and earthquake more severe than the related design basis events. Most countries also confirm this for extreme weather conditions.

With regard to the 72 h site autonomy, all countries with an implemented 72 h site autonomy or a planned implementation after 2019 confirm site autonomy availability in case of an external flooding, earthquake or extreme weather condition more severe than the related design basis events, except the United Kingdom. In the United Kingdom, a 72 h supply function in case of external events more severe than design basis events is organized via combination of on-site and off-site stored deployable back up equipment.

The reported implementation dates range from "2010-2014" (for most countries) "2015-2019" or "after 2019" as an outcome of the post-Fukushima national action plans.

03.3 Timeframe of implementation and timeliness

The selected approach provides information on the time when the safety improvements (technical solutions) have been or will be implemented in the plants.

Time spans of implementing key safety improvements cover periods of 20-25 years or more when looking at all countries. Therefore in some cases an improvement may have been im-

plemented 25 years ago in one country and a similar improvement implemented in the last five years in another.

It is not recommended to simply compare implementation dates or duration periods of specific safety improvements for different countries or reactor types. Ensuring timeliness is a continuous task that starts when the potential need for an improvement has been identified. This may be due to the initial recognition of the issue or reassessment its importance after e.g. PSR or an event on the reactor or some other matter. Assessing timeliness for the implementation of a safety improvement would have to be carried out on a case-by case basis as suggested in the WENRA Guidance on Article 8a of the EU Nuclear Safety Directive: "Timely Implementation of Reasonably Practicable Safety Improvements to Existing Nuclear Power Plants".

Concerning the SRL under the scope of the pilot study WENRA Members had their own regulatory practices related to the time of implementation of modifications and had to consider the plants as a whole which included for example the extent of the improvement.

04
Conclusions to be drawn from the Pilot Study exercise

With regard to the objectives mentioned in section 1 it can be concluded that the pilot study shows that the approach is suitable for:

- data collection and evaluation of the implementation status of SRLs in NPP on the basis of SRL specific lists of safety improvements,
- compiling related implementation time spans in the countries (it has to be emphasized that timeliness of implementation of a safety improvement should only be carried out case-by case) and
- identifying different approaches in order to allow national authorities to learn from each other.

The pilot study provides an overview on the current status of the implementation of the chosen SRLs in the NPPs, which is described in the full report of the sub-group. Different technical solutions to fulfil an SRL were compiled in order to allow learning from each other. It became clear that many safety improvements to comply with the selected SRLs have been implemented long before NSD or VDNS. The pilot study also shows that the harmonization of the safety level of the NPPs in Europe is making good progress.

Within the pilot study RHWG has not reviewed the timeliness of reasonably practicable improvements. It is the responsibility of the national regulatory body to ensure the timeliness s and to take further action to enforce an improvement if necessary. An option for the full study might be to choose one or two recent improvements for each country and present the process in the light of the WENRA guidance.

Beyond the “benchmarking”, the information collected, and lessons learned in the exercise may be useful for harmonization purposes, further development of SRLs or in-depth bilateral exchanges on particular issues.

The pilot study has shown that the chosen approach is feasible, although it is resource intensive. However, this pilot study was not part of the original task given to RHWG, but it gives an opportunity to reconsider the task, its objectives and the benefits in terms of safety.

The intended full study, covering the eleven selected SRLs requires:

- active participation of all WENRA members with operating NPPs,
- appropriate prioritisation of RWHG tasks,
- sufficient time and resources to carry out the task properly (3 -4 years), and
- agreement that the approach serves the purpose of “benchmarking”.