

Position Paper

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on Periodic Safety Re- views (PSRs) taking into account the lessons learnt from the TEPCO Fukushima Dai-ichi NPP accident

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March 2013

01 Introduction

A severe accident involving several units took place in Japan at Tepco's Fukushima Dai-ichi nuclear power plant in March 2011. The immediate cause of the accident was an earthquake followed by a tsunami coupled with inadequate provisions for tsunamis in the original design. Opportunities to improve protection against a tsunami were not taken in a timely and effective manner, which could have been possible for example as part of an effective periodic safety review (PSR) process.

IAEA organised in the end of August 2012 the 2nd Extraordinary Meeting of the Contracting Parties to the Convention of Nuclear Safety. The main topic of the meeting was the lessons learnt from the Fukushima Dai-ichi NPP accident. In the summary report of the meeting, the Contracting Parties were encouraged to reinforce efforts for continuous improvement by performing periodic reassessments of safety, through periodic safety reviews or alternative methods.

The European stress tests organised by the ENSREG also emphasised the importance of the PSR process¹. In the action plan for the follow-up of the peer review of the stress tests performed on European nuclear power plants, ENSREG encourages WENRA to undertake a review of the associated Reference Levels, particularly with respect to external hazards².

Since operation of the first generation of commercial nuclear power plants started in the 1950's, there have been substantial developments in safety standards, operating practices and in technology, resulting from new scientific and technological knowledge. Lessons have been learnt from operating experience and better analytical methods have been developed. These developments should be considered by the licensees and the regulatory bodies in the interest of continuous safety improvement.

One of the key aspects of nuclear safety and continuous improvement is the periodic safety review. WENRA reference levels (RLs) for existing nuclear power plants³ cover the topic of PSR in Issue P. According to the RLs, the PSR shall be made periodically, at least every ten years. The review shall confirm the compliance of the plant with its licensing basis and any deviations shall be resolved. In addition, the review must consider any issues that might limit the future life of the facility or its components and explain how they will be managed. The review shall also identify and evaluate the safety significance of deviations from applicable current safety standards and internationally recognised good practices currently available. All reasonably practicable⁴ improvement measures shall be taken by the licensee as a result of the review.

¹ ENSREG summary report, stress tests performed on European nuclear power plants, April 2012

² ENSREG action plan, Follow-up of the peer review of the stress tests performed on European NPP, July 2012

³ WENRA Reactor Safety Reference Levels, January 2008

⁴ The words Reasonably Practicable are used in terms of reducing risk as low as reasonably practicable or improving safety as far as reasonably practicable. The concept of reasonable practicability is directly

The licensee has the prime responsibility for performing the PSR. The regulator will review the results and can require the licensee to implement additional safety improvements in order to permit continued operation. In the end of the PSR process, the licensee shall collect all reasonably practicable improvement measures in an integrated implementation plan which is agreed with the regulator. The licensee and the regulator inform the government and the public about the scope and the results of the PSR and resulting safety improvements according to the national procedures within the regulatory oversight process. PSR scope, methodology and the roles and responsibilities are described in more detail in IAEA Safety Guide NS-G-2.10 “Periodic Safety Review of Nuclear Power Plants”, August 2003.

RHWG considers it important that the same method of PSR, which takes into account the potential consequences of safety challenges, is used in all phases of operation including the decommissioning phase of NPPs and for other nuclear facilities, such as research reactors and radioactive waste management facilities. Decommissioning phase of nuclear installations is covered by WENRA Decommissioning Safety Reference Levels Report⁵ where RL D-55 says “The licensee shall carry out at regular intervals a review of the safety of the facility under decommissioning at a frequency established by the regulatory body”.

analogous to the ALARA principle applied in radiological protection, but it is broader in that it applies to all aspects of nuclear safety. It should be taken to mean that, in addition to meeting the normal requirements of good practice in engineering, further safety or risk reduction measures for the design or operation of the facility should be sought and that these measures should be implemented unless the utility is able to demonstrate that the efforts to implement the proposed measures are grossly disproportionate to the safety benefit they would confer.

⁵ WENRA Working Group on Waste and Decommissioning (WGWD), Decommissioning Safety Reference Levels Report, version 2.0, November 2011

02

The role of PSRs and the concept of continuous improvement

A strong PSR process is a very important contributor to continuous improvement of safety of nuclear power plants. In case that PSR results indicate the need for improvement measures, these measures are to be defined and implemented in a timely and effective manner.

WENRA published a pilot study on “Long term operation (LTO) of nuclear power plants” in March 2011. A main conclusion of this study was that regulators generally review the acceptability of continued operation through the process of PSRs. Enhancement to the safety level is generally achieved following the PSR process. The scope and the frequency can vary slightly depending on a country's specific practice; however they are on the whole in line with IAEA guidance. In all WENRA countries the general requirements for PSR have been specified in the national legislation and/or regulatory guidelines.

In all WENRA countries, licensees are expected to perform at least every ten years a PSR of their plant, which is an opportunity to review not only the conformity of the plant, but also identify the possible safety improvements. Safety improvements can be related to the plant design but also to organisational issues (management system, procedures,...). On the basis of the results of the PSR, regulators generally review the continued acceptability of the continuation of operation of the plant until the next PSR.

PSR significantly contributes to the continuous improvement of safety. The concept of continuous improvement is illustrated in Figure 1, which is a simplified representation of safety through plant life, and does not for example show the timescales for implementing plant improvements or the effects of ageing of plant systems, structures and components.

When the existing reactors were commissioned, their original safety level met the required safety level based on the safety requirements which were in force then. Safety requirements for NPPs can be updated based on the operating experience and safety research and advances in science and technology. New reactors are designed to meet higher levels of safety than the existing ones. Despite the fact that existing reactors undergo PSRs as a result of which safety enhancements are implemented, it is likely that there will remain a difference between the safety level of oldest and newest reactors. One example is a difference between the severe accident mitigation provisions integrated as a design basis in new reactors compared to the back-fitting measures in the older reactors. In some cases, it will be reasonably practicable to enhance safety to reach a higher safety level but sometimes further enhancement toward the benchmark is not reasonably practicable.

The need for improvements can also occur anytime between PSRs and significant issues that may put at risk the safety of the plant shall be addressed without delay. The safety assessments performed in WENRA countries after the TEPCO Fukushima Dai-ichi NPP accident or the Forsmark NPP event are also examples of actions performed outside the frame of PSRs.

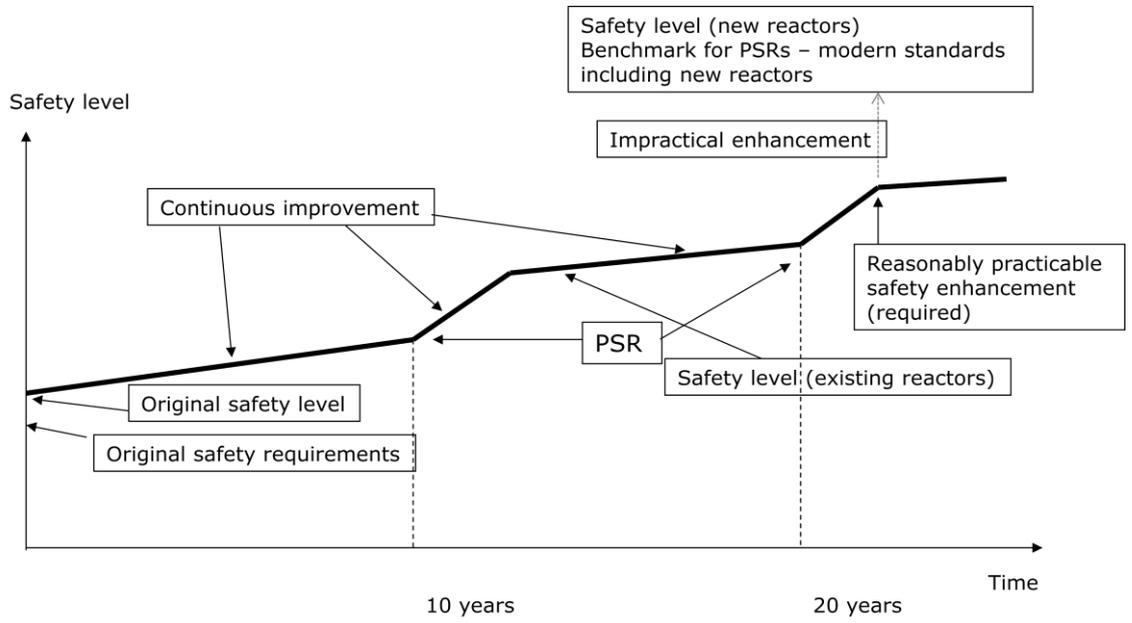


Figure 1. The concept of continuous improvement.

03

Safety standards and internationally recognized good practices used as reference in PSRs

It is stated in WENRA RL P1.3 that the PSR shall “identify and evaluate the safety significance of deviations from applicable current safety standards and internationally recognised good practices currently available”. While developing the pilot study on LTO, the RHWG performed an internal study on the national practices in implementation of RL P1.3. The study was based on a questionnaire concerning the ‘reference level for the PSR’. This term is used in the IAEA Safety Guide NS-G-2.10 to represent the plant level constituted by the applicable safety goals, standards, methods, practices and the plant design basis, which is actually known as ‘benchmark level for PSR’ within the RHWG.

In a questionnaire, a specific item aimed at describing what are the “current safety standards” used in PSRs. The majority of the WENRA countries described them as consisting of the following:

- National nuclear law and regulations;
- National regulatory guidelines and standards; and
- IAEA safety standards;

Many WENRA countries include also

- WENRA Reactor Safety Reference Levels (RLs);
- standards and regulation of the country of origin of the reactor design or other countries; and
- safety requirements for new nuclear power plants;

And some countries include

- the WENRA safety objectives for new nuclear power plants; and
- the current level of science and technology.

In general, the differences in regulations, standards and approaches amongst the WENRA countries are not so large. The attempt to use requirements for new nuclear power plants in the PSR seems to impose a variety in the understanding of the “current safety standards” (from the original design basis, through the design extension and reaching the WENRA safety objectives for new nuclear power plants). However, implementation of all the WENRA RLs for existing reactors has a positive influence for the practical application of the standards in the PSR process. RLs include for example the concepts of design extension and severe accident management, and will be assessed at the latest in the next PSRs as the regulatory requirements continue to be harmonised within the WENRA countries.

In the WENRA statement on safety objectives for new nuclear power plants published in November 2010 it was stated that those objectives should also be used as a reference for identifying reasonably practicable safety improvements for existing plants during periodic safety reviews. Based on these safety objectives, WENRA decided to develop common positions on selected key safety issues for the design of new nuclear power plants. The report compiling these common positions can also be used as a more detailed reference in PSRs.

04

Reassessment of possible plant faults and hazards

The TEPCO Fukushima Dai-ichi accident demonstrates the importance of properly implementing the Defence-in-Depth principle, to ensure safety, getting the design basis for external hazards right, providing adequate protection against external hazards, and the need to ensure a strong PSR process together with independent regulatory body to drive it. The accident has also confirmed the need to undertake a comprehensive analysis of all potential plant faults and hazards as part of the PSRs using both deterministic and probabilistic methods in a complementary manner to provide as full coverage of all safety aspects as possible.

PSR should raise issues for further development of safety and those measures should be timely implemented that can be considered justified considering operating experience and safety research and advances in science and technology. In the safety assessment, specific considerations are needed for multi-unit sites and to address long term measures, as well as to cover all areas with significant amounts of radioactive material at the site.

The current WENRA RL P2.2 states that the scope of the PSR shall be as comprehensive as reasonably practical and defines areas that shall be covered as a minimum. The mentioned areas are derived from the 14 safety factors defined in the IAEA Safety Guide NS-G-2.10. This RL P2.2 mentions safety analyses in general but does not explicitly mention hazard analysis which is one of the IAEA safety factors. In RL P2.2, safety analyses include the analysis of plant faults and of hazards and also credible combinations and induced effects. They constitute both deterministic and probabilistic aspects.

IAEA Safety Guide NS-G-2.10 defines the safety factor of hazard analysis as to ensure that SSCs important to safety, including the control room and the emergency control centre, are adequately protected against relevant internal and external hazards. For this safety factor, the PSR review should take into account the current methodology, analytical methods, safety standards, knowledge of credible magnitude and associated frequency of occurrence of the hazard (and uncertainty related to this knowledge), understanding of environmental effects, the capability of the plant to withstand the hazard based on its current condition, and appropriateness of operating organisation procedures to prevent or mitigate the hazard.

For external hazards, the list of relevant hazards that may affect plant safety shall be reviewed for completeness in PSRs. For each relevant hazard, the PSR shall verify, by means of current methodology, analytical techniques and data, that the frequency of occurrence and/or the consequences of the hazard are sufficiently low so that either no specific protective measures are necessary, or that the preventive and mitigatory measures in place are adequate. For example, there should be an assessment of the impact of any changes in hazard levels, due to changes in hazard magnitude derivation methodologies. If the hazard level has changed the SSCs which are expected to resist the hazards should be reassessed to confirm their hazard withstand capability.

Due to the Fukushima Dai-ichi accident the European stress tests (ENSREG) was performed which included the assessment of external hazards including in particular earthquake, flooding, and extreme weather conditions and combination of hazards. As part of the PSR process, the safety justification against external hazards shall be re-evaluated at least every ten years if not specifically addressed otherwise.

On multi-unit sites, the plant should be considered as a whole in safety assessments and interactions between different units need to be analysed. Hazards that may affect several units need to be identified and included in the analysis. It would be preferable to carry out the site specific studies for all units at the plant site at the same time, taking into account the possible interactions among different units. Even if some PSR studies were applicable to several similar NPPs, site specific aspects should be reviewed separately in PSRs.

05

Possible changes in PSR procedures based on the lessons learnt from the TEPCO Fukushima Dai-ichi accident

Concerning the scope of PSR, it is recognised that natural hazards should be more systematically reviewed during a PSR. No major modifications are expected concerning the PSR process itself. However, it is expected that WENRA countries take measures to make the process as transparent as possible to the stakeholders and the public. For example, the outcome of the PSR including resulting safety improvements should be published. This should improve societal confidence on the nature and scope of the PSR and the licensees commitment to address any PSR findings.

06

The need to update WENRA RLs related to PSR

The IAEA Safety Guide NS-G-2.10 is currently under revision. No major modifications are planned in the latest draft of this revision which would influence significantly the current WENRA RLs Issue P.

As lessons learnt from the Fukushima Dai-ichi NPP accident, the following areas are recognised for improvements in the WENRA RLs Issue P:

- the timely and effective implementation of improvements derived from the PSR
- review of site characteristics regarding external hazards
- more explicit guidance on the need for comprehensive analysis of all hazards and plant faults
- taking into account multiple-unit issues.

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