

A Study of Improvements to a Periodic Safety Review According to WENRA Reference Levels

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1. Introduction

In many countries around the world, various organizations have been established to improve the safety and reliability of nuclear power plants. The safety of nuclear power plants has been improved through exchanges of information among member states. In Europe, the Western European Regulators Association (WENRA) was established to develop a common approach to nuclear safety and to provide an independent capability to examine nuclear safety in member countries. In addition, the Reactor Harmonization Working Group (RHWG) was organized to harmonize safety approaches in early 2000s. The RHWG identified 18 safety areas in which reference levels (RLs) are required to minimize differences in safety regulations. Through a comparative review of the 18 areas of member states, the regulatory systems and their implementation statuses were identified and improvements were derived.

The periodic safety review (PSR) is a comprehensive and documented type of review that can be used to ensure that a plant is safe overall. Since 2000, Korea Hydro & Nuclear Power (KHNP) has conducted PSRs for its commercial nuclear power plants. By performing these multiple times for NPPs, KHNP has established a formalized evaluation method. However, a comparative analysis with other countries' systems has not conducted thus far to improve these PSR assessment methods. In this paper, through the evaluation method proposed by the WENRA RHWG, the level of the PSR system in Korea was identified and some improvements were suggested.

2. WENRA PSR reference level

In the early 2000s, nine member countries conducted pilot studies to develop a systematic evaluation method for nuclear safety issues [1]. For the completion of this methodology, eight additional countries joined, and a total of 17 countries formed the RHWG. During the selection of the safety issues, issues that were not important for harmonization were excluded. The safety issues selected in consideration of harmonization are structured in five areas: safety management, design, operation, safety verification, and emergency preparedness. The PSR is classified as belonging to the safety verification area.

The RHWG presented nine reference levels to cover the objectives, scope and methodology of PSRs. The nine RLs proposed by WENRA are as follows:

1. The licensee has the major responsibility for a PSR.
2. Compliance with the licensing basis shall be confirmed, and any deviations shall be resolved.
3. Identify and evaluate the safety significance of deviations from applicable current safety standards and international practices
4. The licensee provides practicable improvement measures as a result of the review.
5. An overall assessment of the safety of the plant shall be provided and adequate confidence in plant safety for continued operation shall be demonstrated.
6. A review should be done periodically, at least every ten years.
7. The scope should be clearly defined and justified. It shall cover the 14 safety factors of SSG-25 [2].
8. Deterministic as well as probabilistic assessments should be included in the review.
9. Each area shall be reviewed and the findings compared the licensing requirements as well as to current safety standards and practices.

3. Periodic Safety Review

The safety features of nuclear power plants are inspected primarily by routine reviews (including reviews of modifications to hardware and procedures, significant events, operating experience, plant management and personnel competence) and special safety reviews following major events significant to safety. Complementary to the routine and special reviews, PSRs are used to evaluate the comprehensive status of a plant and to determine if the plant status is satisfactory such that it can operate for ten more years based on the evaluation of the previous ten-year operation status. During the evaluation, compliance with its licensing basis is reviewed and reasonably practicable safety enhancements are determined to improve the level of safety. Figure 1 shows the concept of a safety improvement of a NPP. The safety level based on the initial licensing conditions is usually improved by corrective actions for any issues found in relation to plant activities during regular operation. The

PSR is a measure complementary to other activities. It is used to review all NPP activities over the previous ten years and to evaluate comprehensively their global effects on the plant.

The objective of a PSR is to ensure a high level of safety throughout the plant's operational lifetime by systematically assessing the cumulative effects of plant ageing, plant modifications, operating experience, technical development and siting aspects.

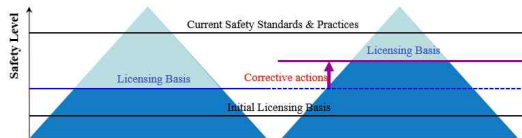


Fig. 1. Safety improvements to correct PSR findings

4. PSR Evaluation with the WENRA Reference Level

South Korea, as a member of the IAEA, started to conduct PSRs for Kori Unit #1 in 2000 and established related laws in 2001. At this time, KHNP has finished its first PSRs for the relevant NPPs, and several NPPs are undergoing their second PSR processes. KHNP has carried out nearly 20 PSRs and established a solid evaluation system. However, unlike in Europe, there was no opportunity to draw improvement points through a comparison analysis with other countries. At present, the regulatory body intends to improve the PSR system in accordance with relevant nuclear safety regulation policies. Therefore, through this comparative study using the WENRA PSR RLs, evaluations of the PSR position comparable to those done in Europe are conducted and improvement points are determined.

As described above, the PSR RLs consist of nine units, and the first five represent the objectives of PSRs. In accordance with the nuclear safety regulations, the nuclear licensee conducts a PSR to ensure the safety of the nuclear power plant. The legal bases for conducting PSRs are as follows:

- Nuclear Safety Act Article #23
- Presidential Decree Articles #36, 37, 38, and 39
- Ministerial Ordinance Articles #20 and 21
- NSSC Official Notifications

In this evaluation, not only domestic technical standards but also international standards and practices are referenced. The safety enhancements derived from the evaluation are updated according to the implementation plan to improve nuclear power plant safety.

The next two RLs constitute an evaluation of the scope of the PSR. The IAEA PSR guidelines

specifically describe safety factors by which items should be evaluated during the PSR process. The safety factors are selected on the basis of international experience and are intended to cover all important plant safety features. After accepting the concept of safety factors, the Korean government passed ministerial ordinance Article #20 to guide the conducting of PSRs. In it are clarified a total of 68 evaluation items for 14 safety factors. KHNP conducts PSRs every ten years, and article #20(1) of the ministerial ordinance describes the details of a PSR evaluation. In addition, the examination contents are described in the regulatory examination guidelines. Currently, the PSR evaluation proceeds according to Korean legislation. However, in the current evaluation, the technical standards selection procedure is completed by the licensee. Therefore, there may be differences in the criteria applied to the evaluation at the time of the regulatory review. In such a case, certain aspects of the evaluations are conducted again.

The last two RLs are the evaluation items pertaining to the PSR methodology. In the PSR evaluation, an appropriateness evaluation of the deterministic safety analysis (DSA) and a probabilistic safety analysis (PSA) are conducted according existing technical standards. In addition, a gap evaluation of the power plant licensing standards and applicable current technical standards is conducted. This analysis also covers the operational experience of the power plant and the utilization of study results.

5. Conclusion

KHNP fulfilled the requirements of PSRs as stated in the RLs proposed by the WENRA RHWG. As stated in the IAEA SSG-25 and in Nuclear Safety Act Article 23 of Korea, the KHNP successfully conducted PSRs as scheduled for all NPPs. The efforts by the KHNP to maintain and improve nuclear safety were confirmed. However, clarifying the technical standards and the scope of such evaluations with the regulatory agency beforehand would make the evaluations more practical.

REFERENCES

- [1] "Harmonization of Reactor Safety in WENRA Countries", WENRA RHWG, 2006
- [2] "Periodic Safety Review for Nuclear Power Plants", IAEA SSG-25, 2013