

Examination of Effective Measures to Implement PSR in an Enhanced PSR Environment

Kim Jeung-Wook
KHNP Central Research Institute
kimjwook@khnp.co.kr

1. Introduction

Over 20 years have passed since a Periodic Safety Review (PSR) was conducted on the Kori-1 reactor in 2000. It was the first attempt of a PSR for a domestic nuclear power plant. Since then various system improvements have been made in the field, and, in 2019, more significant changes are expected to be made to the PSR system; for example, the Nuclear Safety and Security Commission (NSSC) has been pushing to strengthen the PSR regulations by adopting the PSR approval system. Going forward, PSR evaluation methods will continue to be changed, and PSRs will also need to be conducted for permanently shut-down nuclear plants and lifetime extension. Therefore, there will be an increasing number of nuclear reactors subjected to PSRs moving forward. Against this backdrop, the present study aims to examine measures to implement PSRs in an efficient and timely manner.

2. Analysis and Improvement Directions

2.1 Overview of PSR

The PSR is a system that aims to comprehensively evaluate the safety of nuclear power plants in operation at an interval of ten years. Since the adoption of the PSR system was recommended by the International Atomic Energy Agency (IAEA), starting with the Kori-1 reactor in 2000, a total of 22 PSRs have been conducted, including 20 for nuclear plants in operation and two for safety assessment to determine lifetime extension. The Nuclear Safety Act, which requires the performance of PSRs, was revised to reflect the details of the IAEA Guide (SSG-25, September 2013) [1] in November of 2014. Aside from the 11 existing safety factors, three new factors (Plant Design, Hazard Analysis, and Probabilistic Safety Assessment) were added, and the number of evaluation items increased from 55 to 68.

Table I: PSR Safety Factors

14 IAEA PSR Safety Factors (68 items)		
Actual Condition of SSCs Important Safety (6)	Equipment Qualification (6)	Ageing (5)
Deterministic Safety Assessment (4)	Safety Performance (5)	Procedures (5)
Use of Experience from Other Plants and Research Findings (2)		Organization, the Management System and Safety Culture (7)

Human Factors (5)	Emergency Planning (6)	Radiological Impact on the Environment (5)
Plant Design (5)	Hazard Analysis (3)	Probabilistic Safety Assessment (4)

2.2 PSR Management Enhancement

As part of the Comprehensive Measures to Enhance Nuclear Safety Standards [2] announced in October of 2018, PSR enhancement measures were prepared, and attempts to enact them are currently being pursued at the working level. These measures primarily concern matters regarding the adoption of the PSR approval system, application of the latest technology standards, and mandatory implementation of safety improvement measures. If the PSR approval system is put in place, a business operator must submit a PSR report to regulatory authorities, and the report must be reviewed and approved within 24 months from the date of submission. To receive approval from regulatory authorities within the prescribed period, the business operator must be able to efficiently respond to evaluation inquiries.

2.3 Background for Evaluation Inquiry Analysis

This analysis aims to analyze the details of the previous PSR evaluation inquiries that have been conducted for the last five years especially with regard to the trend of plant-specific evaluation inquiries, the current status of field-specific and factor-specific evaluation inquiries, and the trend of current-status analysis items for each evaluation inquiry type. By doing so, it is necessary to come up with measures that ensure the timely completion of the evaluation, for example, by preventing the recurrence of similar evaluation inquiries and improving the quality of PSR evaluations.

2.4 Evaluation Inquiry Analysis Results

According to the current status analysis of plant-specific evaluation inquiries, the number of evaluation inquiries for the Kori-3, 4 reactors and Hanbit-3, 4 reactors increased approximately by 250. This is ascribed to the effect of the newly enacted safety factors (Plant Design, Hazard Analysis, and Probabilistic Safety Assessment) [3].

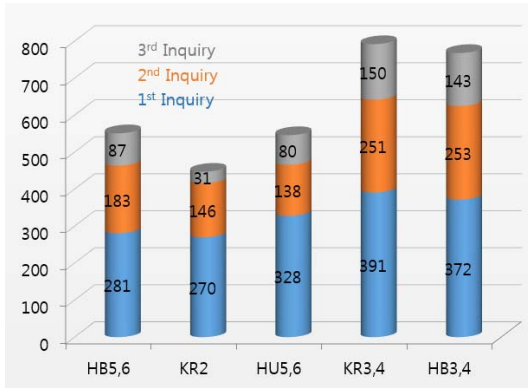


Fig. 1. Current Status of Issuance of Plant-specific Evaluation Inquiries

Notably, the number of evaluation inquiries regarding the PSA field significantly increased from 20 to 130.

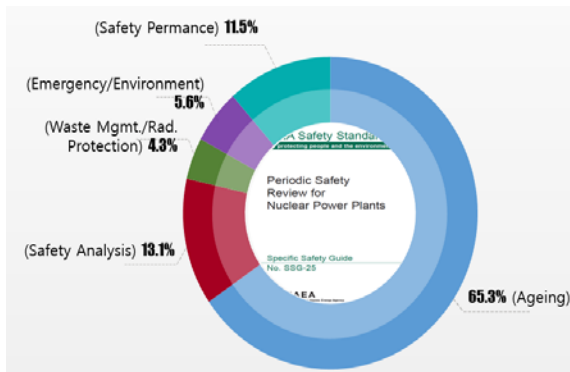


Fig. 2. Current Status of Issuance of Field-specific Evaluation Inquiries

According to the current status analysis of safety factor-specific evaluation inquiries, those regarding Aging and Actual Condition of SSC accounted for about 35.2%, followed by 15.7% for the PSA field and 11.6% for Deterministic Safety Analysis [4].

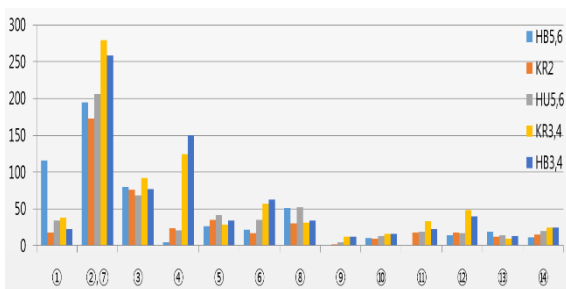


Fig. 3. Current Status of Safety Factor-specific Evaluation Inquiries

According to the current status analysis of content-specific evaluation inquiries, those regarding the demand for detailed explanations accounted for 52.5%, the highest, followed by 25.4% for the submission of relevant detailed information, 17.3% for the request for

revising reports to supplement evaluation results, and 4.8% for the request for the application of the current technology standards.

2.5 Improvement Direction Regarding the Response to Evaluation Inquiries

The most recent evaluation inquiries were conducted on the Kori-3, 4 reactors and Hanbit-3, 4 reactors, where 60 to 70% of the inquiries made were repeated ones. In this regard, it is important to proactively respond to given inquiries in the first place. Also, for inquiries that apply to all entities or require reevaluation or policy decisions, preliminary reviews need to be implemented while preparing countermeasures through the analysis of previous evaluation cases so that evaluations can be completed within the prescribed period.

3. Conclusions

To respond to the evaluation inquiries given by regulatory authorities more systematically and efficiently going forward, it will be necessary to establish a comprehensive system capable of analyzing periodic trends of evaluation inquiries, for example, by subdividing the trend analysis codes, developing relevant procedures (guidelines), and supplementing the PSR Integrated Management System [5].

REFERENCES

- [1] IAEA No.SSG-25, Safety Guide on Periodic Safety Review of Nuclear Power Plants, 2013.09
- [2] Comprehensive Measures to Enhance Nuclear Safety Standards (Plan), Nuclear Safety and Security Commission, 2018.09.18
- [3] Article 20 (Details of Periodic Safety Review) of the Enforcement Regulations for the Nuclear Safety Act
- [4] Evaluation Inquiries for the Kori-3, 4 reactors and Hanbit-3, 4 reactors
- [5] Operation Manual for the PSR Integrated Management System