Future Regulatory Research Needs on Risk-Informed and Performance-Based Regulation

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1. Introduction

The USNRC has pursued the incorporation of risk-informed and performance-based regulation (RIPBR) into nuclear safety regulatory system, as an alternative to improve existing nuclear safety regulation of nuclear power plants, which is deterministic and prescriptive. It focuses on the use of risk insight from probabilistic safety assessment (PSA).Recently, it becomes necessary to find a way to improve regulatory efficiency and effectiveness in order to cover the increasing regulatory needs in Korea. Also, the utility has optimized design and operation of the plant using PSA insight and equipment performance information. According to the increase of the necessity for regulatory improvement using risk and performance information, KINS (Korea Institute of Nuclear Safety) is developing, as a part of a mid and long-term project of Nuclear R&D program, how to adopt the RIPBR in Korean nuclear regulatory system. As the interim results, three basic directions and several principles that are necessary to implement RIPBR model were already identified from the previous study [1-2]. This paper suggests a direction to future regulatory research on RIPBR based on the previous studies including the review of international trend of RIPBR and the evaluation of risk-informed regulatory environment.

2. Development of Korean Models for RIPBR

2.1 Basic directions and Principles for RIPBR in Korea

Korean approach to RIPBR has been established from previous study. In the study, objective of adopting RIPBR was setup to achieve the following through improving and complementing existing regulation considered as deterministic and prescriptive, and based on risk and performance information:

- To improve plant operational safety by managing and monitoring the risk and safety performance
- To optimize regulation by improving regulatory effectiveness and efficiency and by reducing unnecessary regulatory burdens, and
- To enhance public confidence on nuclear safety

Three directions for developing Korean RIPBR models were established in the study ; (i) introduction and application of RIPBR as supplementary means to existing deterministic regulatory approach with preserving the defense-in-depth philosophy; (ii) selection of models within the scope proven to be effective and efficient by international practice and experience; and (iii) adoption of models in a systematic, integrated and phased manner in consideration of the level of technology, regulatory environment and public acceptance in Korea. Also, several principles were set for supporting the basic directions.

2.2 Korean Models for RIPBR

For selecting Korean RI-PBR model, the candidates were identified by review of Korean and international experiences and practices on RIPBR. The candidates were subjected to assessment against screening criteria. A total of 24 items was selected to be included in Korean RIPBR models and categorized into five areas; (i) regulatory inspection, (ii) amendment of licensing basis, (iii) safety requirements and guides, (iv) common technologies, and (v) regulatory technologies. Table 1 shows the items selected for further detailed assessment to establish Korean RIPBR models. It could be very hard to implement all the items listed in Table 1 due to the limitations of resources. According to the second direction mentioned in section 2.1, it is necessary to select models proven to be effective and efficient by international practices and experiences. Regulatory research should focus on the selected models.

3. Status of Risk-Informed Regulatory Environment

3.1 International trend of RIPBR Implementation

Table 2 presents the status of implementation for the selected RI-PBR items in some countries. From the review of international experiences and practices on RI-PBR, it can be summarized [3] that (i) there exists a big gap between the USA and other countries, (ii) regulatory applications of risk insights are limited to the areas where RIPBR can be applied with no significant change of existing regulatory framework, and (iii) common items implemented include RI-TS, RI-ISI, risk monitor, and risk-informed regulatory inspection. Therefore, these items should first be considered in establishing future regulatory research plan.

3.2 Status of Risk-Informed Regulatory Environment

The USNRC is the leading organization in the area of RIPBR and some countries including Spain, Mexico and Switzerland are trying to follow the US practices. But, recent US research results on the status of risk-informed

environment [4] show that there still exist several issues to be resolved for improving risk-informed environment in NRC activities. Following major issues were identified through the focus group and interviews by the USNRC;

- A clear, consistently agreed-upon definition of what is "risk-informed" either doesn't yet exit or not been adequately communicated across the reactor program.
- Non-PRA staff have limited knowledge of existing guidance and current training doesn't help non-PRA experts understand the value of risk-informed approach
- Staff from Headquarters noted that they don't see how risk directly relates to their job

There was a similar survey on Korean nuclear worker's perceptions of RIPBR in 2002 [5]. From the survey, it was found that most of nuclear workers are lacking the knowledge of PSA even though they showed positive views on the current regulation and positive expectations for the regulatory improvement activities in general. The survey concluded that for the institutionalization of RI-PBR, lots of education and training activities are needed and that regulatory frameworks compensating the individual worker's ignorance on risk concept are to be devised. As discussed above, even if good RIPBR models are available, they cannot be easily implemented without improved risk-informed regulatory environment. Therefore, the improvement of risk-informed regulatory environment should be included in the future research plan.

4. Conclusion

The international practices and experiences of RIPBR are reviewed and such items as RI-TS, RI-ISI, risk monitor, and risk-informed regulatory inspection are found to firstly consider in establishing the future research plan. Also, based on the US status and Korean survey of risk-informed environment, it is concluded that future research should focus on how to improve risk-informed regulatory environment.

REFERENCES

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Table 1 Items selected for Establishing Korean RIPBR Models

Categories	Items
A. Regulatory Inspection	A-1 Safety Performance Indicators (SPI) A-2 Risk-informed SPI A-3 Performance-based Inspection (PBI) A-4 Risk-informed Inspection (RII) A-5 Risk-informed and Performance Inspection
B. Amendment of Licensing Basis	B-1 Risk-informed In-service Inspection (RI-ISI) B-2 Risk-informed In-service Testing (RI-IST) B-3 Risk-informed Testing of MOV/AOV B-4 Risk-informed STI/AOT (RI-STI/AOT) B-5 Risk-informed Improved TS (RI-ITS)
C. Safety Requirements and Guides	C-1 Risk-informed Categorization (RISC) C-2 Maintenance Rule (MR) C-3 Combustible Gas Control C-4 ECCS Performance Criteria (ECCS Rule) C-5 Fire Protection Rule (FP Rule) C-6 Pressurized Thermal Shock Rule (PTS Rule) C-7 Risk-informed Licensing (RI-Licensing)
D. Common Technologies	D-1 General Guidance for Use of Risk Information D-2 PSA Standards and Quality D-3 Reliability DB D-4 Training Program D-5 Risk Monitoring System (RM)
E. Regulatory Technologies	E-1 Regulatory PSA Models E-2 ASP Program

Table 2 Comparison of Status of implementing RIPBR

	RI-TS	RI-ISI	RM	PI	MR	Regulatory PSA Model	RII
USA	●	●	●	●	●	●	●
Japan	●			o			o
France	o						
Canada	o					●	
Spain	o	o	●		●	o	●
Switzerland						●	●
Czech Rep.	o	o	●				o
Mexico	●		●		●		●
Korea	●	o	o	●	o	o	o

Note) ● : implemented, o : planned or under development