Development of Domestic Risk Informed Decision Making Framework

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INTRODUCTION

The objective of this research is to develope RIDM (Risk Informed Decision Making) framework for regulatory body of Korea.

The plan for RIDM framework development consists of three steps:

Step 1. To identify candidates which can be enhanced by PSA in regulatory activities of KINS,

Step 2. To assess candidates and select action items

Step 3. To develop detailed procedures and software tool for action items.

In step 1~2, almost all regulatory activities of KINS have been analyzed by the expert panels, and more than 40 candidates were identified. Several action items were derived among these candidates by expert panels with consideration of improvement and feasibility (Ref.1). In step 3, draft guidelines and PSA analysis tool have been prepared for regulatory staffs.

BACKGROUND

Since the Severe Accident Policy declaration (2001), licensee (KHNP) has conducted some risk informed amendments. (RI-ISI, RI-AOT, RI-STI etc.) Regulatory body in Korea (NSSC and KINS) has also tried to implement risk-informed activity in domestic regulatory framework; however, significant achievements have not yet been made. The promotions for RIR are listed below:

- Risk-based Inspection and Maintenance rule pilot program (2002)
- Risk-informed graded Inspection pilot program (2006)
- Maintenance Rule Legislation Promotion (2007)
- Report on Implementation status of Risk-informed Regulation to Nuclear safety committee under Ministry of Education and Science (2009)

The dominant factors of resistance are as follows:

A. Lack of consensus concerning tactical approach to increase regulatory efficiency and effectiveness – There is resistance to the concept of allocation of regulatory resource. It also did not match with domestic legislation.

B. Lack of confidence in PSA – Due to the concern about the possibility of arbitrarily assessment, it is hard to utilize PSA on regulation decision making process.

With respect to the former factor of resistance, it is necessary to emphasize that the PSA can give an additional justification for current regulatory activities. In this research, we are focusing on PSA insight to be used for regulatory decision making within a range that does not cause a significant change to the current regulatory system.

And with respect to the latter factor of resistance, we can say that PSA make the uncertainties explicit, which is in fact one of the advantages of PSA.

The confidence in the PSA is based on the understanding of the PSA itself. To understand the strength and weakness of PSA, we need to use it. So, experience of PSA application can promote the confidence and reliability of using the PSA in regulatory body. These three aspects are in positive feedback system. (Fig.1)

The core strategy of implementation is finding and conducting the ‘easy’ and ‘good’ items which have feasibility as well as advantage on regulatory activities for the first experience.

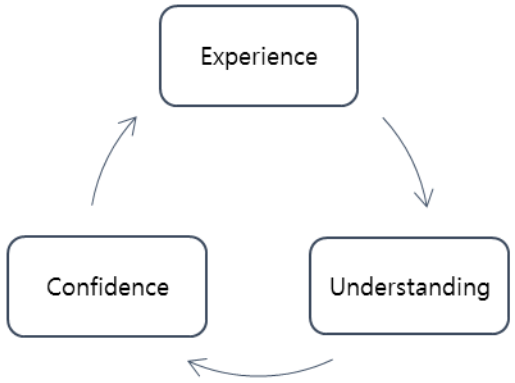

Fig. 1. Positive feedback system in implementation

STEP 1. IDENTIFICATION OF CANDIDATES

The regulatory decision making process is embedded in various regulatory activities. Thus, systematic analysis of regulatory activities was carried out. In Korea, KINS performs nuclear safety regulatory activities (e.g. regulatory review, inspection) except nuclear security activities. Thus, regulatory activities of KINS are listed up as analysis of the work instructions, practice of recent nuclear safety regulatory etc. Table I shows some examples of identified regulatory activities, while table II shows RIDM candidates for each activity.

TABLE I. Example of Identified Regulatory activities

Category		Regulatory Activities
Review (New NPP)	1.1	License Review (Standard Design Approval, Construction Permit, Operating License)
	1.2	Change Review (Construction Permit amendment, Minor change)
Review (Operating NPP)	2.1	Periodic Safety Review
	2.2	Continued Operation (CO PSR, Equipment life assessment, Radiation Environmental Impact Assessment)
	⋮	⋮
Regulatory Inspection	3.1	Pre-operational Inspection
	3.2	Periodic Inspection
	3.3	Quality Assurance Inspection
⋮	⋮	⋮

TABLE II. Example of Identified RIDM Candidates

RIDM Candidates	
1.1.1	Independent validation of submitted PSA compatibility
1.1.2	Derivation of improvement items in regulation perspective
1.1.3	Priority review item selection
1.1.4	Impact assessment of design changes compared to preceding unit
1.2.1	Independent risk impact assessment of construction permit amendment
2.1.1	Independent verification of submitted PSA
2.1.2	Risk assessment of PSR safety improvement plan of licensee
2.1.3	Intensive review items selection
2.2.1	Independent verification of submitted PSA compatibility
⋮	⋮

STEP 2. ASSESSING RIDM CANDIDATES

Guideline to Assess RIDM Candidates

It is preferred to select priority items with consideration both about safety regulation enhancement and feasibility. In SECY-01-0218, "Risk-Informed Regulation Implementation Plan" (RIRIP) (Ref.2), USNRC considered 7 guidelines to select RIR items. In this research, 5 guidelines were developed as follows to consider the objective and strategy.

1. Improvement
   - 1-1 Would a risk-informed approach help to improving the activity's safety? (Very big improvement -5 ~ disagree -1)
   - 1-2 Could a risk-informed approach improve the regulatory decision making process of this candidate? (Very big improvement -5 ~ disagree -1)
2. Feasibility
   - 2-1 Do information (data) and analytical models exist that are of sufficient quality or could they be reasonably developed to support risk-informing regulatory activity? (Sufficient -5 / exist -4 / not exist, but can be developed -3~1)
   - 2-2 Can startup and implementation of a risk-informed approach be realized at a reasonable cost to the regulatory body and licensee? (Very low cost -5 ~ very big cost -1)
   - 2-3 Do other factors exist (e.g., legislative, judicial, adverse stakeholder reaction) which would preclude changing the regulatory approach in an area, and hence limit the utility of implementing a risk-informed approach? (Could be implemented without any rule change, and would be no stakeholder reaction -5 ~ would be impossible -1)

Result of Assessing RIDM Candidates

If none of improvement category items (1-1, 1-2) acquire more than 3 point, the candidate can be screened out because it is hard to justify. And if more than an item of feasibility category (2-1, 2-2, 2-3) acquire less than 3 points, the candidate can be screened out because we can say there are big obstacles in that way. As a result of assessment, 25 items are screened out from a total of 48 items.

For prioritization of candidates, it is needed to consider both improvement and feasibility at the same time. We consider the 2-dimensional space with feasibility average score and improvement average score as x, y axis respectively. Each score was simply normalized to full scale of 10 (Fig.2)

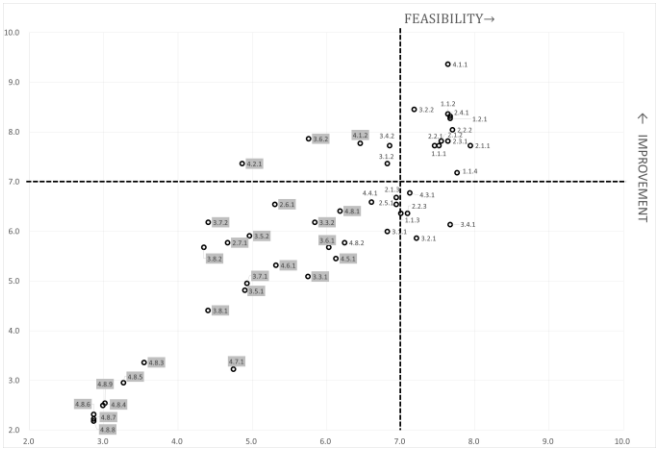

Fig. 2. Prioritization results diagram

This is the final list of selected action items.

1. Accident Sequence Precursor Analysis in incident / accident investigation and follow-up review
2. Significance Determination Process on Inspection Findings which are issued in periodic inspection
3. Derivation of improvement items in regulation perspective in PSAR/FSAR licensing
4. Independent risk impact assessment on amendment request of operating NPP
5. Independent risk impact assessment of PSR safety improvement plan of licensee
6. Independent validation of submitted PSA compatibility in PSR, licensing and continued operation regulatory review
7. Impact assessment of design changes compared to preceding unit in new licensing
8. Daily Inspection observation item selection of resident inspectors

STEP 3. DEVELOPMENT OF PROCEDURES AND SOFTWARE

Development of Procedures

To develope detailed procedures for each action item, we have conducted

1. To survey regulatory guidances related to the action items (Notice of NSSC, Regulatory Standard of KINS, Regulatory Guideline of KINS and procedure of KINS etc.),
2. To develop new activities(assessment, derivation, validation and selection) which can realize that action item and,
3. To develop draft procedure which includes new activities

For example, action item #1 (Accident Sequence Precursor Analysis in incident / accident investigation) is related to two Notice of NSSC and one procedure of KINS. We derived two draft procedures as the new activities which can make realize the action item #1, which are:

(1) Including the risk significance analysis result of the event to the event investigation report which is opened to public
(2) Add a new criteria for event scale determination process

Development of Software for safety significance analysis

For the development of regulatory PSA models (so-called MPAS model) and detailed risk impact analysis, KAERI and KINS are using the AIMS-PSA software. The AIMS-PSA is powerful and user-friendly software, but for RIDM implementation, we need new web-based risk impact analysis tool because of

(1) Accessibility for staffs,
(2) Simplicity in use, and
(3) Convenience of maintenance (it is difficult to maintain all software and model installed in PCs of all staffs).

So we developed new web-based risk significance analysis software, so-called SEM (Significance Evaluation Management) system. (Fig.3)

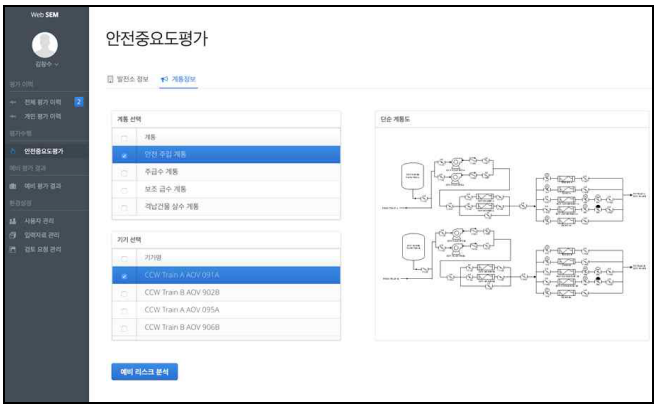

Fig. 3. Screen capture of the SEM system

RESULTS

For implementation of the RIDM framework for regulatory body of Korea, almost all regulatory activities of KINS have been analyzed by expert panels, and several action items have been derived among these candidates with consideration of improvement and feasibility. Moreoever, draft procedures and web-based software have been developed for regulatory staffs.

ACKNOWLEDGMENTS

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1. Dongju Jang, “Regulatory Activity Analysis for RIDM Framework Development”, PSAM13 (2016)
2. USNRC, “Risk-Informed Regulation Implementation Plan”, SECY-01-0218 (2001)