Development of Integrated Safety Performance Assessment (ISPA) Program To Determine the Safety Performance Grade of Nuclear Power Plant

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1. Introduction

Since the beginning of 2000, safety regulation of nuclear power plant (NPP) has been challenged to be conducted more reasonable, effective and efficient way using risk and performance information. In United States, the USNRC established Reactor Oversight Process (ROP) in 2000 for improving safety regulation of operating NPPs. [4] The main idea of ROP is to classify the NPPs into five categories using the results of safety performance assessment and to conduct differentiated regulatory programs according to the categorization, which might be interpreted as "Graded Regulation."

However, the classification of safety performance categories is highly comprehensive and sensitive process so that the program and necessary tools for safety performance assessment should be prepared in integrated, objective and prudent manner. Furthermore, the assessment should characterize the actual level of safety performance of a specific NPP considering the substantial elements which reveal the representative aspects of safety performance.

In consideration of particular environment regarding nuclear industry and regulation in Korea, the integrated safety performance assessment (ISPA) program is being under development for the use in the classification of safety performance categories of NPPs. [1][2][3] The basic concept for ISPA development is the integration of individual regulatory programs related to safety performance. Some of them which already exist are to be used directly or modified to include risk and performance aspects, and those which are not existing regulatory programs are newly developed. Eventually, all the assessment results from individual regulatory programs are produced and integrated to determine the safety performance grade of each NPP.

2. Structure of ISPA Program

The ISPA program consists of six significant individual aspects which represent the safety performance of a plant such as those results from "risk evaluation of inspection findings", "risk-informed performance indicators", "risk monitor", "risk assessment of operational accident/event," "maintenance effectiveness monitoring program", and "licensee safety management system". Each aspect is evaluated by each individual program and the results are integrated to produce overall safety grade of a specific plant. The structure of ISPA program is shown in Fig.1. The six individual programs are under development and three of them which are completed will be explained herein. They are related to the determination of risk significances of inspection findings and operational events and the risk-informed performance indicators.

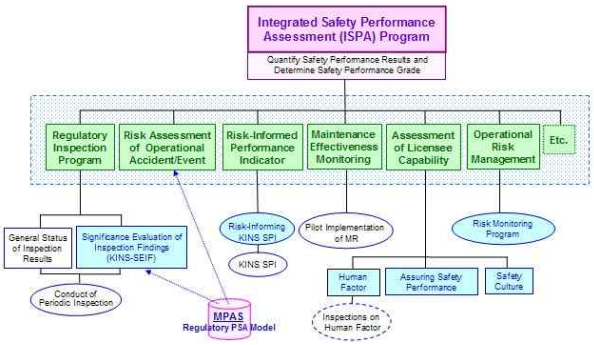

Fig.1 The structure of ISPA program

3. Program for Risk Evaluations of Inspection Findings and Operational Events

KINS-SEIF/ASP Program is developed for evaluating the risk of inspection finding and operational events. KINS-SEIF/ASP stands for KINS-Significance Evaluation of Inspection Findings/Accident Sequence Precursor and is designed to support the inspectors as well as the ISPA program by providing risk significance information of inspection findings and operational accident/events both qualitatively and quantitatively. In support of the inspector, a PC-based fast-running tool is developed for onsite risk significance evaluation by the inspector. The inspector will be aware of (preliminary) absolute and relative risk significance of the inspection finding easily and quickly. With this information, the inspector can take proper regulatory action commensurate with the risk significance

of each inspection finding. In parallel with providing risk information with inspector, results of risk significance evaluation will be refined and interpreted by PSA analyst to produce the safety performance input to ISPA program. The evaluation process inside KINS-SEIF/ASP program is illustrated in Fig.2 and Fig.3 shows a snapshot from computer screen which contains evaluation results.

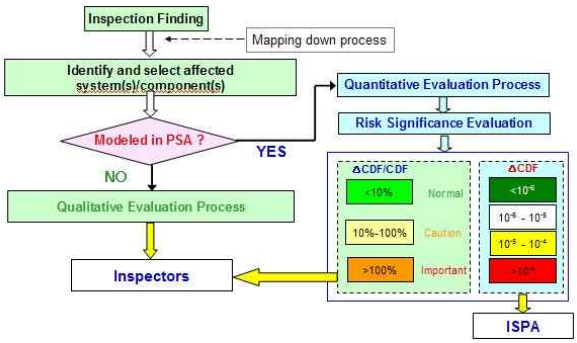

Fig.2 Evaluation process in KINS-SEIF/ASP program

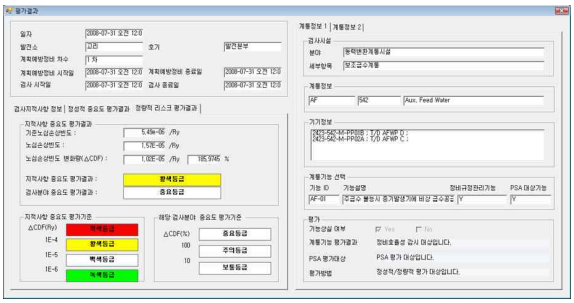

Fig.3 Snapshot from KINS-SEIF/ASP Assessment Result Screen

4. Risk-Informed Performance Indicators

The KINS has already been operating the KINS Safety Performance Indicators (KINS-SPI) since 2000. However, the results of KINS-SPI have been treated as "reference information" because of the lack of technical background and quantitative measures. Therefore, through extending and risk-informing the existing KINS-SPI, the overall safety performance information of a NPP can be produced and it will be used as one of the inputs to the ISPA program. For this purpose, risk-informed performance indicators are developed with two major improvements. [5][6] First, those existing performance indicators in the areas of initiating events and mitigating systems are extended, subdivided and risk-informed. Second, the quantitative criteria of each performance indicators are reviewed and reestablished quantitatively to produce the new risk-informed KINS-SPI. The improvements in risk-informed KINS-SPI are listed in Table 1.

Risk-Informed SPI		KINS SPI (Existing)
Category	**Performance Indicator**	
Initiating Events	Simple Reactor Trip	Reactor Trip
	Unplanned Scram with Complication (USwC)	
	Power Change	Power Change
Mitigating System	MSPI – EDG System	EDG System
	MSPI – HPSIS	HPSIS
	MSPI - AFWS	AFWS
	MSPI – RHRS	
	MSPI – CWS	

Table 1. The result of risk-informing KINS-SPI

5. Conclusions

As a part of KINS regulatory researches program, the integrated safety performance assessment (ISPA) program is being under development since 2008. The KINS-ISPA program consists of six individual sub-programs and three of them which are related to the determination of risk significances of inspection findings and operational events and the risk-informed performance indicators are completed and explained herein. The KINS-ISPA program will be applied to the determination of safety performance grade of each NPP, which, in turn, will be used in differentiating and adjusting regulatory inspection activities and resources according to the safety performance grade of each NPP. Therefore, in parallel, it is necessary to develop the graded periodic inspection (GPI) program by risk-informing the existing periodic inspection program and grading it into several categories corresponding to the safety performance grade

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