

## Development of Draft Technical Requirements for On-line Maintenance

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### 1. Introduction

It is well known that on-line maintenance (OLM) has some potential for safety enhancement of operating nuclear power plants [1]. The Korea Institute of Nuclear Safety (KINS) is developing a regulatory framework for OLM implementation under the auspices of MEST. This paper introduces drafts of regulatory technical requirements which will constitute the regulatory framework for OLM.

### 2. Hierarchy of Technical Requirements (Drafts) for OLM

Hierarchy of technical requirements (drafts) for OLM is shown in Table 1. Top level of the requirements will be the safety criteria and principals for OLM, in the Article 63(4) of the Regulations on Technical Standards for Nuclear Reactor Facilities. The second level of them will be the Maintenance Risk Assessment and Management Regulation, a Notice of the Nuclear Safety Commission (NSC), and it will support licensee to meet the safety criteria and principles for OLM. In the third level, KINS guides will help regulator review and confirm licensee's implementation of OLM.

Table 1 Hierarchy of Technical Requirements (Drafts) for OLM

Technical Standards (NSC Regulation)	Regulations on Technical Standards for Nuclear Reactor Facilities, Article 63 (Testing, Monitoring, Inspection and Maintenance) (4) : <i>Define Criteria and Principal for OLM</i>
NSC Notice	Maintenance Risk Assessment and Management Regulation (Draft)
KINS Guides	<ul style="list-style-type: none"> <li>• Reg. Guide(Draft) for Implementation of Maintenance Risk Management Regulation</li> <li>• Reg. Guide(Draft) for Inspection to Maintenance Risk Assessment and Emergent Work Control</li> <li>• Reg. Guide(Draft) for Inspection to Configuration Risk Assessment and Management Process</li> <li>• Reg. Guide (Draft) for Identification of Violation to Maintenance Risk Management Regulation</li> </ul>

### 3. Criteria and Principles for OLM

The primary intent of the safety criteria for OLM is that, before performing maintenance activities (including but not limited to surveillance, post-maintenance testing, and corrective and preventive maintenance), the licensee shall assess and manage the increase in risk that may result from the proposed maintenance activities. The draft set of safety criteria

and principles in the NSC Regulation are as follows [2];

- Licensee shall assess and manage the increase in risk that may result from the proposed maintenance activities.
- Safety principles for OLM performance as follows:
  - Decision to perform OLM rather than during shutdown should be based on the reasonable expectation of increased system and plant reliability and reduced plant equipment and system material condition deficiencies that could adversely impact plant operations.
  - OLM program should be carefully planned to prevent such abuses that allow performing OLM by repeatedly entering and exiting limiting conditions for operation (LCOs) action statements in the technical specifications.
  - While performing OLM, removing other equipment from service should be decided by risk insights.
    - Confidence in the operability of the independent equipment that is redundant (or diverse) to the affected equipment should be high and bolstered by positive risk management actions such as administrative controls (protected equipment).
    - If a piece of equipment is operable, but is degraded, or is trending towards a degraded condition, the licensee should, in general, avoid removing its redundant counterpart equipment from service for OLM.
  - While performing OLM, the licensee should avoid performing other testing or maintenance that would increase the likelihood of a transient. The licensee should have an assurance that the facility will continue to operate in a stable manner.

### 4. Maintenance Risk Assessment and Management Regulation (Draft)

Maintenance risk assessment and management Regulation (Draft) describes the requirements of maintenance risk assessment and management.

The SSCs subject to a maintenance risk assessment may be limited to the following scope:

- SSCs modeled in the plant's Level one, internal events PSA, and;
- SSCs determined to be high safety significant by the Maintenance Rule expert panel based on engineering judgment and operating experience.

The NSC notice consist of 13 articles as shown in Table 2. Among them, the Article 3, "SSCs in the scope of risk assessment," describes characteristics of the probabilistic safety analysis (PSA) used to define the risk assessment scope. The Article 11, "Managing risk,"

includes the risk management action thresholds on quantitative consideration as shown Table 3.

Incremental core damage probability (ICDP) is the difference in the "configuration-specific" CDP and the baseline (or the zero maintenance) CDP.

Table 2 Contents of the Maintenance Risk Assessment and Management Regulation (Draft)

Article 1	Purpose
Article 2	Definitions
Article 3	SSCs in the scope of risk assessment
Article 4	Preparation of the procedures for risk assessment
Article 5	General guidance for the risk assessment during power operation and shutdown
Article 6	Assessment methods for power operating conditions
Article 7	Quantitative considerations for the assessment during power operation
Article 8	Qualitative considerations for the assessment during power operation
Article 9	Assessment methods for shutdown conditions
Article 10	Additional considerations for the assessment during shutdown conditions
Article 11	Managing risk
Article 12	Mitigating risk
Article 13	Due date of reconsideration

Table 3 the risk management action thresholds on quantitative consideration

ICDP	Actions	ILERP
$> 10^{-3}$	- configuration should not normally be entered voluntarily	$> 10^{-6}$
$10^{-6} - 10^{-5}$	- assess non quantifiable factors - establish risk management actions	$10^{-7} - 10^{-6}$
$< 10^{-6}$	- normal work controls	$< 10^{-7}$

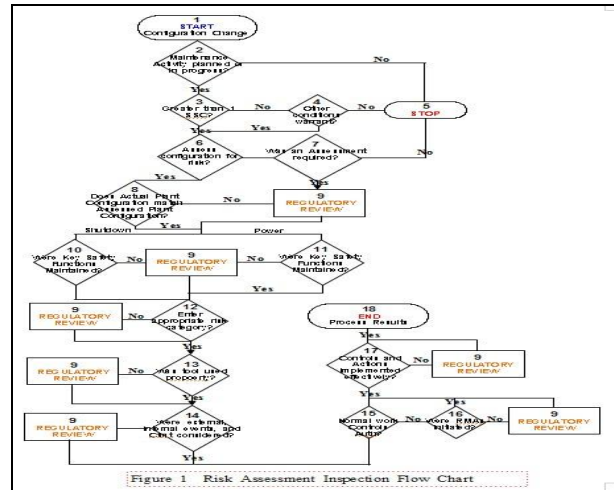
## 5. Regulatory Guides (Draft) for OLM

### 5.1 Reg. Guide (Draft) for Implementation of Maintenance Risk Management Regulation

This guide provides guidance for the development of an approach to assess and manage the risk impact resulting from performance of maintenance activities. Assessing the risk means using a risk-informed process to evaluate the overall contribution to risk of the preventive maintenance activities. Managing the risk means providing plant personnel with proper awareness of the risk, and taking actions as appropriate to control the risk.

### 5.2 Reg. Guide (Draft) for Inspection to Maintenance Risk Assessment and Emergent Work Control

This guide consists of inspection bases, level of effort, objective, requirements, general & specific guidance, and etc. Main items of the inspection requirements are risk assessment and management of risk; emergent work control; and problem identification and resolution. As a specific guidance, flow chart (including blocks numbered), which delineates the structure, logic, and process flow for inspection of licensee activities, is presented as shown in Figure 1.



### 5.3 Guide (Draft) for Inspection to Configuration Risk Assessment and Management Process

This guide consists of inspection bases, objective, requirements, general & specific guidance, and etc. The guide is focused on specific requirements such as scope of SSCs, configuration risk managements, and risk management, including an in-depth review of the licensee's use of PSA and risk assessment tools

### 5.4 Reg. Guide (Draft) for Identification of Violation to Maintenance Risk Management Regulation

This guide supports regulatory inspectors to identify issues whether exist, or not violations of the regulation, and examples of violations.

## 6. Conclusions

We have developed draft technical requirements for OLM. The draft requirements are being reviewed by internal and external experts. After that, they will be finalized through the rule-making process. It is expected that the final guides would be helpful for regulator to review and inspect licensee's OLM activity, as well as licensee to implement OLM.

## ACKNOWLEDGMENT

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## REFERENCES

- [1] Ahn S. K., Lee C. J., and et al, "Analysis of Foreign Countries' Regulatory Technology of On-Line Maintenance," KINS/RR-762, Aug. 2010.
- [2] Ahn S. K., Lee C. J., and et al, "Development of Draft Regulatory Framework for Maintenance at Operating Nuclear Power Plants," KINS/RR-817, Feb. 2011.