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Development of Regulatory Guide for Risk-Informed Tech. Spec. Changes

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1. Introduction

The policy statement on nuclear safety in 1994[1] encourages use of probabilistic safety assessment (PSA) for integrated safety evaluation and implementation of risk-informed regulation (RIR) for improving regulatory efficiency. RIR is to use PSA results and other risk insights in regulatory decision-making on the licensing basis change. Korea Institute of Nuclear Safety (KINS) developed the implementation plan and principles of RIR in response to the policy statement. One activity under way is to use PSA in support of decisions to modify an individual plant's technical specifications (TS). TS contain the items in the following specific categories: safety limit and limiting safety system settings, limiting conditions for operation, surveillance requirements, design features, and administrative controls. Typically the proposed risk-informed change to TS involves an extension of allowed outage time (AOT) or surveillance test interval (STI). There are many applications for TS change of which review is completed or under way as shown in Table 1.

Table 1. Status of application for TS change

Plant	System	Proposed change	Review status
Kori-3&4/ YGN-1&2	RPS/ESFAS	STI(1M→3M)	Completed
UCN-3&4	RPS/ESFAS	STI(1M→3M)	Completed
UCN-3&4	Inverter	AOT(24Hr→7D)	Completed
W-1,2,3,4	EDG	STI(2W→4W)	Under way
UCN-5&6	Battery	STI(12M→18M)	Under way
Kori-2	RPS/ESFAS	AOT(2Hr→4Hr) STI(1M→3M)	Under way

For effective review of risk-informed application, regulatory guides which include requirements for application of license basis change are needed. KINS has developed a regulatory guide KINS/GT-N24[2], describing the general requirements on RIR and including discussion of topics common to all risk-informed applications. To use risk information and insights in TS change, a regulatory guide for specific requirements is needed as well as the guide for general requirements on RIR. The regulatory guide for TS change is under development and the specific requirements for TS change will be described herein.

2. Risk-informed Decision-making Principles

In implementing risk-informed decision-making, TS changes are expected to meet the following set of principles described in KINS/GT-N24. The principles are: change meets the current regulations; change is consistent with the defense-in-depth philosophy; sufficient safety margins are maintained; proposed increases in risk are small and are consistent with the safety goal in the policy on Severe Accident; use performance measurement strategies to monitor the effectiveness of the change.

Given the principles of risk-informed decision-making, a four element approach to evaluating proposed changes is suggested. The four elements are: define the proposed change; perform engineering analysis; define implementation and monitoring program; submit proposed change.

3. Regulatory Positions

Regulatory positions for each element will be discussed here. Element 4 is documentation requirement and lists the documentation which should be included in the submittal, and the detailed discussion will not be described.

2.1 Element 1: Define the Proposed Change

The licensee needs to explicitly identify the particular parts of TS that are affected by the proposed change and identify available engineering studies, methods, and PSA insights which are related to the proposed change. A request for plant-specific TS change should use plant-specific data and not rely solely on generic data or data from similar plant design. The use of other than plant specific data should be justified.

2.2 Element 2: Perform Engineering Analysis

Licensees are requested to provide technical bases for any TS change. The technical bases should be rooted in traditional engineering analysis, and TS change requests based on PSA results alone should not be submitted for review. The licensee should evaluate the proposed TS change with regard to the principles that current regulations are met, that adequate defense-in-depth is maintained, that sufficient safety margins are maintained, and that the proposed increases in risk are small and are consistent with the safety goal in the policy on Severe Accident.

The defense-in-depth philosophy is applied to nuclear power plant traditionally for providing multiple barriers against radioactive materials. The licensee should assess whether the proposed TS change meets the defense-in-depth principle.

The engineering evaluation should be conducted to assess if the impact of the proposed TS change is consistent with the principle that sufficient safety margins are maintained. Sufficient safety margins are maintained when the proposed TS change is not in conflict with approved codes and standards relevant to the subject system, and safety analysis acceptance criteria in the Final Safety Analysis Report (FSAR) are met, or proposed changes provide sufficient margin to account for analysis and data uncertainties.

With regards to evaluation of risk impact, the licensee should address several issues such as PSA quality, PSA scope for TS change evaluations, PSA modeling, assumptions used, sensitivity and uncertainty analyses, use of compensatory measures, and configuration control for AOT change. The quality of the PSA must be compatible with the role that the PSA plays in justifying the TS change. One acceptable way for ensuring appropriate scope, level of detail and quality of PSA is to use the up-to-date standard endorsed domestically and internationally. Example of applicable standard for internal (including internal flood), full power level 1 and limited level 2 analysis is the ASME standard[3]. The scope and level of PSA depend on the type of TS change being sought. As a minimum, level 1 and level 2 evaluations should be performed to calculate core damage frequency (CDF) and large early release frequency (LERF). To evaluate a TS change, the specific systems or components involved should be modeled in the PSA, and the screening criteria and truncation limits should be chosen carefully not to exclude the scenarios relevant to the systems involved. Consistent with the principle that TS changes result in only small increases in the risk, certain compensatory measures that balance the calculated risk increase caused by the changes may be considered. For AOT change, three-tiered approach is appropriate to evaluate the risk. Tier 1 is an evaluation of the risk impact as expressed by the change in CDF and LERF, and the incremental conditional core damage probability (ICCDP) and the incremental conditional large early release probability (ICLERP). Tier 2 is an identification of potentially high risk configurations that could exist if equipment in addition to that associated with the change was to be out of service simultaneously, or concurrent system testing was involved. The objective is to ensure that appropriate restrictions on dominant risk-significant configurations are in place. Tier 3 is the establishment of an overall configuration risk management program to ensure that other risk-significant configurations are identified.

Risk acceptance guidelines discussed in KINS/GT-N24 are applicable to TS AOT and STI change requests. The acceptance guidelines are presented as a function of the risk results in terms of total risk and the ratio of the change in risk to the annual average risk. Figure 1 shows the acceptance guideline for CDF. In case of AOT change, the additional risk acceptance guideline for ICCDP and ICLERP should be met other than the acceptance guidelines in KINS/GT-N24. An ICCDP of less than 5.0E-07 is considered small for a single TS AOT change, and an ICLERP of 5.0E-08 or less is also considered small.

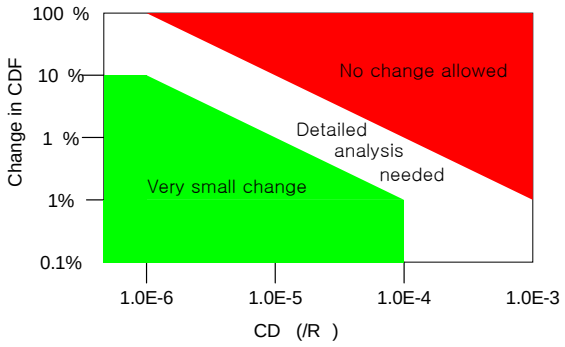

Figure 1. Acceptance guideline for CDF

2.3 Element 3: Define Implementation and Monitoring Program

The licensee needs to use a three-tiered approach in implementing the proposed TS AOT changes. To ensure that extension of a TS AOT or STI does not degrade operational safety over time, the performance or condition of TS equipment affected by a TS change should be monitored. If the licensee concludes that the performance does not meet established performance criteria, appropriate corrective action should be taken.

4. Conclusions

Specific requirements for TS change included in the regulatory guide under development by KINS were presented. Some issues such as PSA quality, configuration risk management program and monitoring strategy will be discussed with the stakeholders in Korea, and the guide may be modified appropriately if needed. This guide as well as KINS/GT-N24 will be utilized for risk-informed TS change, and is expected to contribute to activation of RIR.

REFERENCES

[1] The Ministry of Science and Technology, Policy Statement on Nuclear Safety, September 1994.
[2] Korea Institute of Nuclear Safety, “Regulatory Guide for General Requirements on Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis,” April 2007.
[3] ASME RA-S-2002, “Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications,” April 2002.