Transactions of the Korean Nuclear Society Spring Meeting
Jeju, Korea, May 10-11, 2007

Regulatory Guideline on the General Requirements for Risk-informed Applications

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1. Introduction

PSA (probabilistic safety assessment) has been performed by the nuclear licensees as part of their justification for operational safety or to propose changes to the design or operation of the facilities. The regulatory body must give a guidance to both level of operational safety and any significant changes, and review the PSA as part of the review process to decide whether to give agreement.

The risk information mainly coming from PSA only forms part of the safety justification, which is based strongly on the deterministic arguments used in the design process. Therefore, PSA is complementary to the deterministic safety justification and is considered in conjunction with it. As far as the risk-informed concept is kept in the nuclear society, decisions are not made on the basis of PSA alone, but take into account the totality of the safety case.

US NRC has developed a regulatory guide [1] which gives a direction for using PSA in risk-informed decisions on plant-specific changes to the licensing basis. Referring this approach of US NRC, there is a tendency to develop similar guidelines by the regulatory authorities of Spain, Japan, Switzerland, etc. Recently, we have also developed and officially announced a technical guideline [2] on the general requirements for the licensee-proposed risk-informed changes to the current licensing basis. This paper provides key contents of the guideline, and briefly explains some issues coming from valuable comments by I.S. Kim [3] and many domestic PSA experts during the initial development.

2. Overview of the Guideline

It is generally recommended that the guideline be succinctly streamlined (e.g., in terms of identification of major entities that are required for acceptability of the licensee's risk informed applications (RIAs)), followed by brief delineation of constituent elements associated with each entity, including clear objective of the guideline.

2.1. Objective of the Guideline

The guideline has a major objective for enhancing consistency in the regulatory decision making process for the reviews relating with licensee-initiated RIAs. Also it has the intention to provide the considerations for relevant technical issues and to setup the requirements in assessing the overall effects arisen from the RIAs.

2.2. Contents of Overall Requirements

Five general requirements have been prepared for regulatory decision making (DC), which consist of DC principle, acceptance criteria for DC, DC elements, DC procedure for each element, and appraisal of documentation. In detail, there are 5 items for the DC principle, and 4 DC elements are provided

(1) To identify the proposed change requests of licensing basis,
(2) To perform an engineering analysis,
(3) To maintain the implementation and monitoring program, and
(4) To submit the proposed change requests and documentation.

Within the engineering analysis, it is needed to confirm current regulation, to assess work scope for risk information, to meet acceptance criteria for risk changes, and to identify PSA quality, and so on.

2.3. Finalization of Acceptance Criteria for Risk Changes

We have finalized the acceptance criteria in terms of risk assessment for deciding acceptability of changes due to the submittal of RIAs, which has 3 categories as illustratively shown in Figure 1 in case of core damage frequency (CDF);

(1) Unacceptable region,
(2) Acceptable region,
(3) Region for detailed assessment needed.

3. Issues at the Development Stage of the Guideline

3.1. Establishment of Safety Principles

It is recognized that the guideline appears to be a very important document which sets forth the regulatory position on the risk-informed regulation (RIR). In the guideline, defense-in-depth and safety margins are major principles that should be followed even in the RIR. Therefore, it is needed to emphasize these safety principles especially in the midst of inherent uncertainties of PSA (i.e., with respect to parameters, modeling, and completeness).

For resolving this issue, some explanatory notes are provided to confirm these safety principles, in a section

for the requirement on the implementation of engineering analysis.

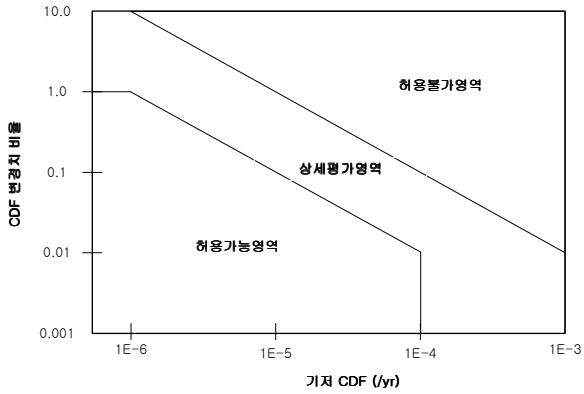

Figure 1. Acceptance Criteria for CDF Changes according to the Proposed RIAs [2]

3.2. Compliance of the PSA Standard

Some experts do not agree the PSA standard documents such as RG 1.200 are definitely needed to confirm the adequacy of PSA quality. It is also indicated that the PSA quality could be evaluated even without such guidance, although those standard documents will facilitate a systematic review of PSA.

For resolving this issue, it is announced that a separate regulatory guideline is prepared by KINS, requiring as-is information and fundamentals for assuring the technical adequacy, in a corresponding section (Section for the requirement on the quality of PSA providing the risk information).

3.3. Acceptance Criteria for Risk Changes

The acceptance criteria for a change in CDF and Large Early Release Frequency (LERF) were originally developed for application to light water reactors. It is recommended that the criteria be extended down to a baseline CDF of 1E-7/yr and a baseline LERF of 1E-8/yr, particularly in consideration of advanced reactors which tend to have lower risk values as compared to the existing fleet of nuclear power plants. At present, the criteria for the region where the baseline CDF (or LERF) is smaller than 1E-6/yr (or 1E-7/yr), are developed in such a way that the lower the baseline CDF (or LERF) is, the more likely the request for a licensing basis change will have to undergo detailed analysis.

Also it is indicated that a concept like LERF may not be applicable to some advanced reactors, and new criteria applicable to all types of reactors are being devised by US NRC as part of Technology Neutral Framework program.

However, it is finally decided not to change the criteria since current concept could give conservative criteria than the recommended one, especially in case of light water reactors. It seems that practical and further considerations are needed for the RIAs to the advanced reactors.

3.4. Consideration on the SSC Classification

It is emphasized that the classification of SSCs (systems, structure, and components) should not be solely based on re-quantification of the risk measures. Rather, it should be based on an integrated decision making considering both deterministic and risk insights. Also it is indicated that SSCs should be classified in principle based on their functional importance as traditionally has been the case. Therefore, what is needed is to ensure that the SSCs must be classified through both functional and risk perspectives, where the risk perspective should incorporate the functional perspective because the former is based on much broader analysis than the latter.

For resolving this issue in the guideline, it is announced that a separate regulatory guideline will be developed by KINS, requiring overall insights including the above point of view.

4. Summary and Conclusions

Domestic guideline for making regulatory decision against licensee-initiated RIAs, has been issued in official version following the KINS document certification process. It is expected that this guideline will be a fundamental helping to establish concrete regulatory position for the embodiment of RIR. This version is being pilot-implemented in an actual case of RIAs such as Tech. Spec. optimization, and may be revised reflecting potential trial-and-errors.

REFERENCES

[1] Regulatory Guide 1.174, Rev.1, US NRC, November 2002.
[2] KINS/GT-Nxx, Technical Guideline on the General Requirements for the Risk-informed Applications in the Submittal for the Changes of Licensing Basis, KINS, March 2007.
[3] E-mail from I. S. Kim (ISL), “Review Comments on the KINS Draft Guideline,” January 24, 2007.