

Feasibility Study on Domestic Application of Risk-informed Changes to 10 CFR 50.46

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1. Introduction

US NRC has been working for the revision of the ECCS technical requirements (10 CFR 50.46) as a part of the implementation of Option 3 proposed from RIPBR and SECY-98-300.

US NRC has been taking the lead at the study for changes of the regulatory technical requirements including the ECCS technical requirements. Because of the technical and economic effects to the nuclear industry, it is expected that most of the countries having NPPs will devote themselves in following and acquiring technology related to these according to American tendencies. Based on this situation, we have carried out the feasibility study on domestic application through reviewing and analyzing the background and status of the revision of ECCS technical requirements which has been carried out actively by US NRC.

2. Analysis and Results

In this section the background and contents of risk-informed changes to ECCS technical requirements will be introduced and the results of feasibility study on the revised proposed rule in the point of safety and economic benefits and the action items for domestic application will be described.

2.1 The background of the revised proposed rule

For LBLOCAs to be rare events the existing ECCS technical requirements were established by deterministic approach with extreme conservativeness. To respond in such LBLOCAs plants focus concern and resource on extremely unlikely events, thereby it is possible not to take appropriate actions against other more likely events caused by initiating events. For this reason NRC has initiated the study for the revision of the ECCS technical requirements by using risk-informed regulatory technology since 2000. On November 7, 2005, NRC announced the revised proposed rule. According to ACRS recommendations related to defence-in-depth and the comments of the Commission, the NRC staff modified and republished the revised proposed rule on August 10, 2009. The final revised rule will be submitted to NRC Commission in June, 2010 [1].

2.2 Contents of the Revised Proposed Rule

The revised proposed rule lets licensees choose the risk-informed alternative requirements in lieu of the

existing ECCS technical requirements.

The most significant feature in the revised proposed rule is that it divides the spectrum of LOCA break sizes into two regions separated by the Transition Break Size (TBS). The first region includes small size breaks up to and including the TBS and all LOCAs of this region are analyzed by the same conservative model, assumptions and criteria currently used for LOCA analysis. The second region includes larger size breaks than the TBS up to and including the DEGB of the largest RCS pipe and LOCAs of this region may be analyzed using more realistic methods and assumptions based on their lower likelihood. Although LOCAs of break sizes larger than the TBS would become "beyond design basis accidents", the revised proposed rule would require that licensees maintain the ability to mitigate all LOCAs.

The use of the alternative ECCS technical requirements would provide licensees with opportunities to change facility design. Potential design changes include modifying containment spray designs, modifying core peaking factors, modifying setpoints on accumulators or removing some accumulators from service, eliminating fast starting of one or more emergency diesel generators, and increasing power, etc.

NRC will periodically evaluate LOCA frequency information. If estimated LOCA frequency increase causing a significant increase in the risk associated with breaks larger than the TBS, NRC would undertake rulemaking to change the TBS.

2.3 The feasibility of the revised proposed rule

NRC, NEI and Westinghouse analyzed safety and economic benefits associated with the revised proposed rule as summarized below.

- In a regulatory analysis NRC estimated that there would be economic benefit of 128 M\$ per unit of PWR by using the revised proposed rule [2].
- NEI analyzed various safety effects obtained by using the revised proposed rule qualitatively [3].
- Westinghouse evaluated the safety benefits qualitatively and quantitatively. In the quantitative analysis only safety effects related to EDG delay and containment spray delay were considered, and even in the restricted analysis it was estimated that significant risk reduction could be achieved [4]
- Westinghouse also evaluated economic benefits quantitatively and concluded that the use of the revised proposed rule could bring out significant

economic benefits (more than 116 M\$ per unit) similar to the NRC regulatory analysis [5].

It is very difficult to quantify all aspects of safety and economic effects associated with the revised rule and there is a great deal of uncertainty in such an analysis. Thereby the analysis result can be different and depends on domestic situations. However, in the analysis of NRC and Westinghouse they concluded that there are significant economic benefits as well as safety benefits. Therefore it is worthwhile for domestic licensee to use the revised rule and if the safety is assured, it is expected that the regulatory authority will precede the revision of rule related to ECCS technical requirements.

2.4 Technical and Institutional Action Items

In this study the technical and institutional action items for domestic application of the revised proposed rule are derived. In implementing of these technical and institutional action items it is desirable to take advantage of the experience and technology of USA for an earlier and effective domestic application. For the things which are difficult to apply to domestic environment or not compatible with domestic conditions it would be preferable to meet them by proposing other alternatives. The technical and institutional action items for the domestic application of the revised proposed rule are presented in Table I.

Table I: Technical and institutional action items for domestic application

Item	Contents
Technical action item	<ul style="list-style-type: none"> • Base establishment for revision of ECCS technical requirements <ul style="list-style-type: none"> - Determination of transition break size - Establishment of deterministic evaluation system - Establishment of risk-informed evaluation system - Development of performance surveillance program • Establishment of implementation system of risk-informed ECCS technical requirements <ul style="list-style-type: none"> - Development of maintenance system for risk evaluation - Development of implementation system for ECCS performance surveillance
Institutional action item	<ul style="list-style-type: none"> • Announcement of risk-informed and performance-based regulatory policy • Publication of regulatory guideline related to PSA quality requirements • Publication of risk-informed decision-making system • Establishment of in-service requirements • Change of regulatory related to ECCS technical requirements

Although it was described that the revised proposed rule could be applied to design of new NPPs, it focuses on currently operating NPPs. In case of application of the revised rule to new NPPs it will be necessary to modify technical requirements specified for currently operating NPPs.

Therefore in order to apply the NRC's revised rule to new NPPs in Korea, it is necessary to modify appropriately technical requirements related to plant modifications in the revised rule or develop new technical requirements. Also in risk criteria related to accident mitigation for new NPPs, it should be decided whether the large early release frequency or the large release frequency be used.

3. Conclusions

We reviewed the background and status of risk-informed changes to ECCS technical requirements proceeded by US NRC as a part of RIPBR and Option 3 and evaluated feasibility in the point of safety and economic benefits for domestic application. We also derived technical and institutional action items for domestic application through this study. This study results can provide the fundamental information of risk-informed changes to ECCS technical requirements and may be utilized as the technical and economic feasibility material in establishing effective working plan to be most suitable in domestic conditions for risk-informed changes to ECCS technical requirements

REFERENCES

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- [4] WOG-05-370, Westinghouse Owners Group Report Evaluating Potential Safety Benefits of Redefining the Large Break Loss of Coolant Accident(LBLOCA) Design Basis Break Size in 10CFR50.46(MUHP-3062), Aug. 2005.
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