

## Perspective on US NRC Policy Issues Concerning Use of Risk Insights for Non-LWR

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### 1. Introduction

Since the PRA Implementation plan of US NRC (1994), PRA has been applied to all NPPs in USA and risk insights have been used for the regulation as a complement of the deterministic approaches. RIRIP (Risk-Informed Regulation Implementation Plan, 2000) and RPP (Risk-Informed and Performance-Based Plan, 2007) were announced by US NRC thereafter, which recommended enhanced use of risk insights. In the meantime, there have been lots of policy issues concerning use of risk insights for licensing Non-LWR designs, which will be discussed in this paper to understand the stream of perspectives on US NRC's approach.

### 2. Policy Issues Concerning Use of Risk Insights [1]

SECY-02-0139 discussed the technical-related policy issues resulting from the PBMR (Pebble Bed Modular Reactor) pre-application activities that may have generic application to other non-LWR designs. In terms of risk insights, the NRC staff (hereinafter "the staff") discussed the Commission's expectations for enhanced safety for future non-LWRs, event selection, and safety classification. The staff did not provide detailed recommendations but future plan.

In SECY-03-0047, the staff provided options and recommendations for the above issues. Innovative designs for safety enhancement and their performance to be proved in high uncertainty areas were recommended for the Commission's expectations. In addition, the integrated risk posed by multiple reactors (ex. modular reactor) and the incremental risk to the surrounding population from adding additional units should be considered. For the event selection, the staff recommended putting emphasis on the use of risk information by allowing the use of a probabilistic approach in the identification of events to be considered in the design, provided there is sufficient understanding of plant and fuel performance and deterministic engineering judgment is used to bound uncertainties. The staff also recommended allowing a probabilistic approach for the safety classification of structures, systems, and components (SSCs). In addition, the single-failure criterion was recommended to be replaced with a probability (reliability) criterion. In SRM (Staff Requirement Memorandum; June 26, 2003) on SECY-03-0047, the Commission approved the staff's

recommendations on the issue of the Commission's expectations with the exception of accounting for the integrated risk posed by multiple reactors. The Commission provided a direction that the staff should provide further details on the options for, and associated impacts of, requiring that modular reactor designs account for the integrated risk posed by multiple reactors. The Commission approved the staff's recommendations on the issues of the probabilistic event selection, safety classification and reliability criteria. The staff provided additional options and considerations for the issue of the integrated risk in SECY-04-0103. The staff also said it would further evaluate and provide options and recommendations in coordination with the development of the technology-neutral framework for new plant licensing.

In SECY-03-0059, the staff discussed its plan to develop a technology-neutral, risk-informed structure for new plant licensing. In SECY-04-0157, the staff provided a status paper on the regulatory structure for new plant licensing including a summary of the technology-neutral framework (TNF). Risk assessment would have a more prominent and fundamental role in the licensing process than it does today under 10 CFR 50, since the risk assessment would be an integral part of the design process and licensing analysis. Because of this more prominent use of PRA, the TNF is considered fully risk-informed [2].

In SECY-05-0006, the issues discussed above have been addressed in the TNF. In performing risk assessments, the staff's practice has been to consider the risk to the public on a per reactor basis, regardless of the number or the megawatt thermal size of the reactors on a site. This was the case in the Individual Plant Examination program and is still the case in current risk-informed activities. For modular reactor designs, the staff has developed a proposed position as follows: the integrated risk will assess accident prevention, independent of reactor power level; and the integrated risk will account for the effect of reactor power level in assessing accident mitigation for modular reactor designs. For the safety level, the staff proposed a safety philosophy directly tied to the Commission's 1986 safety goal policy (51 FR 28044); that is, the staff proposed that the technology-neutral requirements be written to achieve the level of safety defined by the safety goal policy QHOs (Quantitative Health Objectives). The Commission approved the use of probabilistic criteria for identification of events that

must be considered in the design, for safety classification of SSCs and to replace the single failure criterion. In SECY-05-0130, the staff provided options and recommendations to the Commission on level of safety, integrated risk. The staff recommended that the implementation of enhanced safety for new plants by specifying a minimum level of safety (i.e., level of risk) that new plants must meet, and that this minimum safety level will be the QHOs. Also, the staff recommended the criterion that the integrated risk only associated with new reactors (i.e., modular or multiple reactors) at a site does not exceed the risk expressed by the QHOs.

In its SRM on SECY-06-0007, the Commission directed the staff to provide its recommendation on whether and, if so, how to proceed with rulemaking for risk-informed, performance-based technical requirements for future reactors. In SECY-07-0101, the framework was discussed and the staff recommended the deferral of such rulemaking until after the development of the licensing strategy for the NGNP (Next Generation Nuclear Plant) or receipt of an application for DC (Design Certification) or a license for the PBMR, which was approved by the Commission in its SRM on SECY-07-0101. The staff issued the technology-neutral framework as NUREG-1860, "Feasibility Study for a Risk-Informed and Performance-Based Regulatory Structure for Future Plant Licensing," in December 2007 [2]. NUREG-1860 provides an approach and criteria that (1) could be used to develop an alternative set of technical requirements to 10 CFR Part 50 applicable for future non-LWR NPPs (the framework includes a proposed draft set of technical requirements), and (2) could be used to establish risk-informed licensing basis events and the safety classification of SSCs. In the licensing strategy for the NGNP (in a report to Congress in August 2008, "Next Generation Nuclear Plant Licensing Strategy"), the Secretary of Energy and the Commission jointly determined that the best option for licensing the NGNP prototype would be to use a risk-informed and performance-based technical approach that employs the use of deterministic judgment and analysis, complemented by NGNP-specific PRA information. In the NGNP licensing strategy, the Commission concluded that once NGNP technology is successfully demonstrated through operation and testing of the NGNP prototype, and a quality PRA that includes data from operation of the prototype becomes available, greater emphasis on a design-specific PRA to establish the licensing basis and requirements will be a more viable option for licensing a commercial version of the NGNP reactor. Potential issues concerning use of risk insights for SMR (Small Modular Reactor) were also addressed in accordance with the NGNP licensing strategy in SECY-10-0034.

In SRM-COMGBJ-10-0004/COMGEA-10-0001 (August 31, 2010), the Commission directed the staff to develop a design-specific, risk-informed review plan for each iPWR (integral PWR) to address pre-

application and application review activities. Over the longer term, the Commission directed the staff to develop a new risk-informed regulatory structure, building on insights from iPWR reviews, NGNP review activities, and NUREG-1860. In SECY-11-0024, the staff has developed a more risk-informed and more integrated review framework for pre-application and application review activities pertaining to iPWR designs, which is consistent with current regulatory requirements and Commission policy statements and builds on the staff's current application review process. The staff has developed an approach for creating, over the longer term, a new risk-informed and performance-based regulatory structure for licensing advanced reactor designs (e.g., HTGRs and LMRs).

### **3. Perspective on Use of Risk Insights for Non-LWR**

Risk-informed approaches use risk insights complemented by deterministic insights, because there are limitations associated with uncertainties in assumptions, models, data, and methods used in PRA. If PRA technologies become perfect, risk-based approach may be available. Recently, risk-informed approaches in various areas such as RI-IST, RI-ISI, GQA and etc. have been applied to existing NPPs. From the NGNP licensing strategy, the NRC Commission is thought to conclude that the current quality of PRA technologies is not sufficient to use risk insights for licensing future Non-LWR designs. Hence, the TNF would be pending until successful demonstration of the NGNP prototype and a quality PRA. On the other hand, a risk-informed approach for iPWR licensing was still proposed by the staff focusing on a graded approach for the review of SSCs. The most detailed review is conducted for SSCs determined to be both safety-related and risk-significant, and a progressively less detailed review applied to SSCs determined to be non-safety-related or not risk-significant.

### **REFERENCES**

- [1] SECY Documents, <http://www.nrc.gov/reactors/advanced/policy-issues.html>.
- [2] NUREG-1860, Feasibility Study for a Risk-Informed and Performance-Based Regulatory Structure for Future Plant Licensing, US NRC, 2007.