

## Analysis of the Concept and Implementation Status of Performance Based Regulation for Nuclear Power Plants

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### 1. Introduction

Performance based regulatory approach, as opposed to prescriptive regulatory approach that has been used from the early days of the nuclear industry, is gradually being utilized in the international nuclear community. In particular, it is being widely used, in combination with risk-informed approach using probabilistic risk analysis (PRA) complementary to the traditional deterministic analysis.

To have better understanding of performance based regulation, the concept of performance based regulation, its advantages and disadvantages, and implementation status have been analyzed. The results are described herein. Also, the success conditions to implement the approach are presented.

### 2. The concept of performance based regulation

When a regulation sets performance goals, and allows individuals and firms to choose how to meet them, it is called a performance based regulation (PBR). Specifically, a regulatory system that is based on performance can be thought of as one in which performance is used as (1) the basis for the legal commands found in regulatory standards, (2) a criterion for allocating enforcement and compliance resources, (3) a trigger for the application of differentiated (or tiered) regulatory standards, and (4) a basis for evaluating regulatory programs and agencies [1].

A performance standard specifies the outcome required but leaves the concrete measures to achieve that outcome up to the discretion of the regulated entity. In contrast to a design standard or a technology-based standard that specifies exactly how to achieve compliance, a performance standard sets a general goal and lets each regulated entity decide how to meet it. When setting standards, regulatory agencies usually select a point on a spectrum running from what might be considered “pure” performance standards to “pure” design standards, depending on the level of discretion afforded the targets of regulation. [1], as shown in Figure 1.

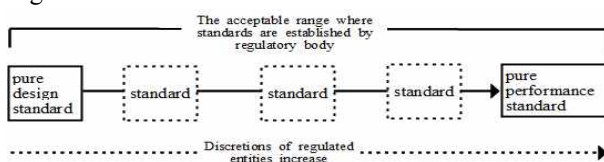


Fig.1. Regulatory Approach Spectrum

In the IAEA technical document [2], performance based approach allows the plant operator and the regulatory body to have much more freedom in determining measures that can be taken to meet the goals.

#### 2.1 The characteristic of performance-based regulation

A performance based regulatory approach is one that establishes performance and results as the primary basis for regulatory decision-making, and incorporates the following attributes [3];

- measurable (or calculable) parameters (i.e., direct measurement of the physical parameter of interest or of related parameters that can be used to calculate the parameter of interest) exist to monitor system, including facility and licensee, performance,
- objective criteria to assess performance are established based on risk insights, deterministic analyses, and/or performance history,
- licensees have flexibility to determine how to meet the established performance criteria in ways that will encourage and reward for improved outcomes, and
- a framework exists in which the failure to meet a performance criterion, while undesirable, will not in and of itself constitute or result in an immediate safety concern.

#### 2.2 Comparison between prescriptive regulation and performance-based regulation [4]

A performance-based regulatory action achieves defined objectives and focuses on results. It differs significantly from a prescriptive action in which licensees are provided detailed direction on how those results are to be obtained. For example, in the reactor arena, one can envision a U.S. Nuclear Regulatory Commission (NRC) regulatory concern involving the reliability of emergency backup diesels during station blackout accidents. A prescriptive approach would direct the licensee to perform specific detailed maintenance operations, testing procedures, and inspections at precise time intervals. A performance based approach would simply set a performance objective (e.g., diesel reliability of 95 percent) and allow the licensee considerable freedom in how to achieve that performance objective.

### 2.3 The advantages and disadvantages of performance-based regulation

Performance-based regulatory approaches possess inherent strengths that can lead to more effective regulation. Advantages of PBR are as follows [1];

- flexibility to both industry and regulator,
- choice of the lowest cost-method to achieve a certain performance goal,
- tolerance of changes in technology and the advent of the new disaster, and
- visualization of a good or a bad trend in performance.

Disadvantages of PBR are as follows [1];

- difficulties in setting reasonable performance standards,
- presence of uncertainty in the implementation of performance standards,
- abuse of discretion, and
- appearance of hindrance during the transition from existing regime to performance based regime.

### 3. Implementation status of performance-based regulation

#### 3.1 The United States of America [3]

(1) Regulatory requirements for operating nuclear power plants

- Generic Letter 93-05, “Line Item Technical Specifications Improvements to Reduce Surveillance Requirements for Testing During Power Operation”
- “Implementation of the LBB methodology for nuclear power reactors” in NUREG-0800
- The “as low as is reasonably achievable (ALARA)” provisions in 10 CFR 20
- 10 CFR 50.65, “Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants”
- 10 CFR 50, Appendix J, “Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors”

(2) Regulatory requirements for design of nuclear power plants

- Reg. Guide 1.208, “A Performance-based Approach To Define the Site-specific Earthquake Ground Motion”
- The use of inspections, tests, analyses, and acceptance criteria (ITAAC) within 10 CFR 52

(3) Reactor Oversight Process (ROP)

In the ROP, we can find an example of the objectives hierarchy, as shown in Figure 2.



Fig.2. Reactor Oversight Process Objective Hierarchy

### 3.2 The Republic of Korea

In Korea, even though many of regulatory research activities related to performance based regulation have been performed, it has been applied only to the limited areas, such as ALARA provisions in the nuclear regulation and the Notice of Nuclear Safety and Security Commission No. 2012-16, “Standards for Leakage Rate Tests of Reactor Containment.” [5] Also, there are some nuclear industry’s activities to apply it in operating areas, such as development of the improved standard technical specifications for NPP, and voluntary implementation of the maintenance rule.

### 4. Conclusions

Performance based regulation is one of useful regulatory approaches. It will contribute to the enhancement of nuclear regulatory system’s effectiveness and efficiency. Examples include improving the objectivity and transparency of regulatory decision-making, promoting licensee flexibility in response to regulatory requirements that can reduce licensee burden, and promoting safety by focusing achievement of performance goal.

To implement it successfully, there are some conditions to be satisfied as follows;

- sufficient understanding of the concept of performance based regulation,
- combination with risk-informed regulation to create synergy effect,
- sufficient communication between regulators and regulated entities prior to implement it,
- production and maintenance of reliable performance data by the regulated entities, and
- social consensus on performance based regulation.

Also, expanding use of performance based regulation will be helpful to the effective regulatory source management and the promotion of voluntary safety activities.

### REFERENCES

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