

Preliminary Study on the Establishment of Regulatory Infrastructure for a Commercial SMART Licensing

Young Gill Yune*, Kyung Wan Roh, Dong Gu Kang, Hho Jung Kim, and Jong Chull Jo
*Safety Issue Research Dept., Korea Institute of Nuclear Safety, Yuseong-gu, Daejeon 305-338, Korea, *ygyune@kins.re.kr*

1. Introduction

The SMART, an integral type of PWR with the capacity of 330MWth, has been developed for multi-purposes such as seawater desalination, ship propulsion, and district heating in Korea since early 1990s. The basic design of the SMART had been completed in 2002. For the demonstration of the safety and performance of the SMART, a project to construct a 1/5 scaled-down prototype reactor with capacity of 65MWth, called as SMART-P(SMART Pilot Plant), has been performed from 2002 to 2006 [1]. However, in 2006, the project to construct the SMART-P was replaced with a preliminary project to develop a commercial SMART in order to advance commercialization of the SMART.

Since the SMART is the first commercial reactor adopting the integral design concept and new system/components such as passive residual heat removal system, canned motor pump, and helical tube steam generator in Korea, some verification tests need to be performed to demonstrate the safety and performance of the SMART. Also, since several new design computer codes that have not yet been confirmed by the regulatory body are expected to be used in the design, some validation tests should be performed to demonstrate their applicability for important accident phenomena.

In order to carry out the SMART development project satisfactorily and to prevent any undesirable delay of licensing process, it is necessary to establish a well-planned verification test program in advance through the early identification of the scope and items of the verification tests. Also, the issues for which either policy decision-makings or detailed technical evaluations are needed should be identified in an early stage of design, and the regulatory positions for the issues should be provided either timely or in advance. Advance identification of regulatory requirements/guides to be amended or newly developed enables to provide regulatory directions for such items in the early stage of design.

The objective of this paper is to introduce the current status of the regulatory activities for the preparation of the forthcoming licensing review of the commercial SMART.

2. Identification and Resolution of Safety Issues

For ensuring the safety and identifying the licensability of the commercial SMART in advance, it is necessary to identify and resolve the potential safety issues [2]. In order to identify the safety issues of the commercial SMART, the following tasks have been done: review of the applicability of the safety issues of the ALWR of the USNRC as well as those of the SMART-P to the commercial SMART; and the preliminary review of design features. The identified safety issues have been classified in accordance with categorization criteria as shown in Table 1.

Table 1 Classification of safety issues

Category	Codes	Criteria
----------	-------	----------

Policy Issues	PI	Decision-makings are needed for the resolution of safety issues
Requirement Issues	RI-1	Design is deviated from the current regulatory requirements establishment of regulatory position is required for the resolution of safety issues
	RI-2	Amendment/development of regulatory requirements are required for the resolution of safety issues
Technical Issues	TI	Detailed safety evaluations and confirmations are required for the resolution of safety issues

A total of 19 safety issues (4 policy issues, 7 requirement issues, and 8 technical issues) have been identified and they are introduced in Table 2.

For each safety issue, technical background, design status, relevant requirements/guides, and directions for possible resolutions have been provided except 3 issues which are excluded due to design changes.

A brief summary will be addressed in the following paragraphs about the identified safety issues.

2.1 Policy Issues

Policy issues, related to the policy decision-making, are reviewed to determine the regulatory directions for the issues. The policy issues addressed involves validity of current method to determine the EPZ, severe accident design, application scope of the risk-informed regulation, level of details of the application documents for standard design approval. The regulatory direction has been provided for each policy issue.

2.2 Requirement Issues

For the preparation of the commercial SMART licensing, it is necessary to identify what design topics or areas can not be addressed by the existing regulatory requirements/guides, and to develop new regulatory requirements/guides for such topics and areas, if necessary [3].

Through the evaluation of applicability of the current regulatory requirements/guides to the commercial SMART, 7 requirement issues have been identified, which are related to unfulfillment, amendment, or development of regulatory requirements/guides. Due to design change, 2 issues have been withdrawn and the regulatory positions have been provided for the remaining five requirement issues.

2.3 Technical Issues

Through the reviews of the design concept of the commercial SMART, the licensing review results of the

SMART-P, and the licensing issues for IRIS and AP-600, 8 technology issues have been identified to confirm the safety of the commercial SMART. One technology issue has been withdrawn due to design change. 7 technology issues have been reviewed and the regulatory directions have been determined and presented for the issues.

Table 2 Potential safety issues related to commercial SMART design

Category	Codes	Titles
Policy Issues	PI-01	Reduction of Emergency Planning Zone
	PI-02	Severe Accident Design
	PI-03	Application Scope of Risk-Informed Regulation
	PI-04	Level of details of the Application Documents for Standard Design Approval
Requirement Issues	RI-1-01	Performance Criteria of the PRHRS
	RI-1-02	Extension of the Periodic Inspection Interval Due to the Extension of the Fuel Cycle
	RI-1-03	Pressure-Temperature Curve for Reactor Heat-up
	RI-2-01	Use of Physically Based Source Terms
	RI-2-02	Exemption of OBE Design
	RI-2-03	Regulation of Safety Guard Vessel and Confinement*
	RI-2-04	Regulation of Active Non-Safety Systems used to Assist Passive Safety Systems*
Technical Issues	TI-01	Demonstration of the Safety and Performance of the Newly Designed System and Components
	TI-02	Verification of New Computational Codes for Design
	TI-03	In-Service Inspection for Major Components
	TI-04	Verification of Prevention of Multiple Breaks of Pipes Penetrating Reactor Vessel Head
	TI-05	Breaks of Reactor Coolant Pump Guide Tube
	TI-06	Design Suitability of Soft Controller
	TI-07	Defence against Common mode Failure of Digital I&C Systems
	TI-08	Environmental Qualification of Equipment *

* Excluded due to design changes

3. Verification Tests and Confirmatory Evaluation Technology

The design concept of the commercial SMART, the licensing review results of the SMART-P, the PIRT of the SMART-P [4], and the verification tests for IRIS [5] and AP-600 have been reviewed. The verification tests to confirm the safety and performance of the design as well as the validity of design computer codes have been identified as the review results.

The identified verification tests are categorized into two groups: separate effects tests for the verification of the safety and performance of newly adopted components, and integrated tests for the verification of the safety of the interaction between the systems and for the demonstration of integrated performance of systems.

The existing confirmatory evaluation technologies have been reviewed in the aspect of its applicability to the commercial SMART. And confirmatory evaluation technologies needed either to be improved or to be developed have been identified in the fields of reactor core design, accident analysis, structural integrity, and severe accidents including PSA.

4. Concluding Remarks

In this paper, the current status of the regulatory research activities for preparation of the forthcoming licensing review of the commercial SMART has been introduced.

The regulatory directions provided for the policy issues can be applied to the licensing of the commercial SMART. Also, the results obtained from this research can be utilized as guidelines to establish design directions in the commercial SMART development project to be performed in the future. The regulatory positions for technology issues identified to secure the safety of the commercial SMART will be directly used in the establishment of design directions.

Both items related to unfulfillment, amendment, or development of regulatory requirements/guides, and the confirmatory evaluation technologies needed either to be improved or to be developed will be used as research and development items in the succeeding main project.

The verification tests identified in this study to confirm the safety and performance of the commercial SMART will be utilized as a guideline in the selection of verification tests needed to be performed by the designer.

Early stage development of regulatory infrastructure through the above-mentioned activities will contribute to increasing the licensability as well as ensuring the safety of the commercial SMART.

REFERENCES

- [1] J. C. Jo, Y. G. Yune, W. S. Kim, C. Y. Yang, I. G. Kim, M. J. Jung, H. J. Kim, and S. O. Yu, Jun. 2006, "Development of Regulatory Technology for the SMART Research Reactor," Proc. 2006 KNS Autumn Annual Meeting.
- [2] Y. G. Yune, K. W. Roh, H. J. Kim, and J. C. Jo, Jun. 2006, "Development of Regulatory Technology for Commercial SMART," Proc. 2007 KNS Spring Annual Meeting.
- [3] J. C. Jo, et al., Development of Regulatory Technology for SMART-P, Research Report KINS/GR-332, Korea Institute of Nuclear Safety, 2006.
- [4] Korea Institute of Nuclear Safety, Safety Evaluation Report for SMART-P, KINS/AR-856, Oct. 2006.
- [5] IRIS Pre-Application Review Meeting Handout, Westinghouse, Feb. 2005.