Implication on Korea's Exemption Regulation through a Review of Foreign Exemption Procedures

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1. Introduction

The Korean regulators consider improvement of the current regulatory framework due to the innovative Small Modular Reactor (i-SMR) which has various unique technologies (soluble boron-free, infinite cooling, manufacturing technology, AI, remote diagnostics, and validation). The United States Nuclear Regulatory Commission (U.S. NRC) and Canadian Nuclear Safety Commission (CNSC) have applied the existing regulatory framework based on large nuclear power plants (NPP) to SMR, while the exemptions or alternative approaches have been used to deal with the unsatisfied with regulatory requirements. The Korean regulatory framework has exemption requirements similar to the US-specific exemptions, but there are difficulties in practical application. It is necessary to clarify the judgment criteria for the exemption in the case of Korea, which does not set separate regulatory requirements considering the characteristics of SMRs. To this end, it is necessary to establish a specific way to deal with the domestic exemption based on foreign regulatory requirements and examples.
Therefore, this study investigated the foreign exemption regulatory requirements and related cases and suggested implications for the application of domestic exemption regulatory requirements.

2. Foreign Regulatory Requirements related to Exemptions

2.1 U.S. Exemptions

The U.S. regulates exemptions from licensing requirements for nuclear facilities in 10CFR50.11 (Exceptions and exemptions from licensing requirements), which provides for general exemptions for facilities related to government ownership or military use, and 10CFR50.12 (Specific exemptions), which provides for specific exemptions from certain licensing requirements upon application by the operator.

Concerning general exemptions, 10CFR50.10 (License required; limited work authorization) establishes a general mandatory licensing requirement for production or use facilities that prohibit use without a license, except as provided in 10CFR50.11 (Exceptions and exemptions from licensing requirements).

The regulations in 10CFR50.11 also govern facilities owned by the U.S. Government, including the manufacture, production, or acquisition by the Department of Defense of facilities authorized for use under Section 91 of the Atomic Energy Act, or the use of such facilities by the Department of Defense or persons under contract with the Department of Defense at the Department's expense.

Specific exemptions are described in 10CFR50.12 (Specific exemptions), as shown in the box below.

> "… (2) The Commission will not consider granting an exemption unless special circumstances are present. Special circumstances are present whenever--
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> (i) Application of the regulation in the particular circumstances conflicts with other rules or requirements of the Commission; or
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> (ii) Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule; or
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> (iii) Compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated; or
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> (iv) The exemption would result in benefit to the public health and safety that compensates for any decrease in safety that may result from the grant of the exemption; or
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> (v) The exemption would provide only temporary relief from the applicable regulation and the licensee or applicant has made good faith efforts to comply with the regulation; or
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> (vi) There is present any other material circumstance not considered when the regulation was adopted for which it would be in the public interest to grant an exemption. If such condition is relied on exclusively for satisfying paragraph (a)(2) of this section, the exemption may not be granted until the Executive Director for Operations has consulted with the Commission.…"

Section 52.7 (Specific exemptions) of 10CFR Part 52 requires that the specific exemption procedures in 10CFR50.12 be followed unless Part 52 provides different criteria. It also expects that the specific exemption requirements (10CFR53.080, Specific exemptions) contained in the draft rules currently being developed for the licensing and regulation of new nuclear power reactors (10CFR Part 53) are the same as in 10CFR50.12.
The C.1.7 (Exemptions, Departures, and Variances) in RG 1.206 (Applications for Nuclear Power Plants) [1] specifies the information that must be included as follows when applying under 10CFR Part 52.7.

- Scope and summary of the exemption application
- Justification about the specific application.
- A technical/regulatory assessment of the safety significance and regulatory tolerance criteria (e.g., 50.12 Section VIII of referenced DC rule)
- An assessment of whether applicable exemption criteria are met
- A statement of the need for NRC authorization or exemption.

For the U.S. NRC, the following LIC-103 document provides specific guidance for the NRC staff in processing exemptions.

2.2 NuScale Exemption Regulations Application

The NuScale conducted a gap analysis [2] of the NuScale reactor design to identify design features that do not meet existing regulatory requirements and requested a exemption of those requirements [3]. The exemption application addresses the following for each regulatory requirement for which a exemption is requested, which appropriately reflects the guidance in RG 1.206

- Introduction & Request
- Justification for Exemption: Technical Basis, Purpose and History of Requirement, Risk Assessment, as required.
- Regulatory Basis: Description of applicable requirements in 10CFR50.12 (Specific Exemptions)
- Conclusion

NuScale submitted a request for exemption from the U.S. NRC's general regulatory requirements 10CFR50.10 and 50.11 and specific exemptions 10CFR50.12 in the December 2016 NRC submission of its Standard Design Approvals Application on the basis that NuScale's unique design is exempt from the application of rules that have been applied to existing large nuclear power plants. NuScale submitted 17 exemption requests for licensing regulatory requirements based on gap analysis reports already performed. In September 2020, the NRC approved the final safety assessment report for the NuScale US 600 SMR design, including the 17 exemption requests.

2.3 Exemptions to Canadian Regulatory Requirements

Section 11 (Alternative Approaches) of the Canadian Nuclear Safety Commission's (CNSC) regulatory document REGDOC-2.5.2 (Design of Reactor Facilities: Nuclear Power Plants) [4] recognizes that the regulatory requirements in this document are technology-neutral for water-cooled reactor designs and that Alternative Approaches may be used for certain other technologies.
The CNSC applies an alternative approach in case 1) the alternative approach provides an equivalent or superior level of safety; 2) the application of the requirements of this document (REGDOC-2.5.2) conflicts with other rules or requirements; and 3) the application of the requirements of this document is inconsistent with its underlying purpose or is not necessary to achieve the underlying purpose. The CNSC staff reviewed whether the alternatives would 1) meet the purpose of the requirement; 2) meet high-level safety objectives; 3) meet essential safety functions; and 4) demonstrate defense in depth, safety margins (including uncertainties in the safety case and consideration of specific hazards over the life of the facility).
The CNSC Strategy for Regulatory Preparedness for New Reactor Technology [5] states that these alternative applications do not imply a reduction or exemption from the applicable regulatory requirements, but rather that the regulatory framework provides the flexibility necessary for the license holder to propose alternative approaches to achieve the intent of the requirements. In addition, the CNSC has the final authority to determine whether the requirements have been met.
Canada's provisions and intent for alternative approaches are consistent with the U.S.-specific exemptions and appear to be consistent with the U.S. flexible regulatory process.

3. Korean regulatory requirements and applicability of exemptions

In the case of domestic exemption clauses, Article 3(2), Article 11(2), and Article 85-2(2) (Scope of application) of the Regulations on Technical Standards for Nuclear Reactor Facilities, Etc state that "Among the technical standards as provided in the foregoing Paragraph (1), certain standards may not apply in those cases where it is acknowledged by the Nuclear Safety and Security Commission (NSSC) that such standards are not directly applicable to the relevant reactor facilities due to the difference in the purpose of, the operational principle of, or the design features of such facilities, or that safety is not affected even if such standards are not applied".
Despite the above regulatory requirements, no exemption has been applied in Korea. This is because it is the responsibility of the applicant to prove that the

purpose of use, the difference in principle, or design features are an exception to the application of existing technical standards and that safety is not impaired, and it is impossible for the regulator to predict the applicant's unique intentions in advance. Therefore, efforts have been made to establish a separate examination plan on a case-by-case basis to ensure that the current level of safety is appropriate for the applicant's exception. However, light water SMRs currently under development are expected to be designed by miniaturizing/modularizing reactors, making it difficult to apply existing regulatory requirements. Therefore, it may be necessary to stipulate and apply procedures to handle exceptions.

Korea has a similar regulation to the US 10CFR50.12 (Specific Exemption) in the nuclear field, but it is comprehensive and abstract, which can cause considerable confusion in its application. Therefore, in Korea, which does not set separate regulatory requirements considering the characteristics of SMRs, it is necessary to clarify the judgement criteria for exclusion requirements to promote regulatory efficiency and licensing stability.

4. Conclusion

This study investigated and analyzed foreign exemption regulations and systems, and examined in detail the specific exemption application in the United States. Referring to the examples of exemption regulations abroad, the applicability of exemption regulations in the domestic regulatory system was examined in preparation for the standard design approval review of i-SMRs and the licensing of general-purpose light water SMRs in the near future.

Through this review, it was confirmed that specific application procedures are needed to apply the exemption provisions in Korea in practice based on the examples of the US-specific exemption and the Canadian alternative application regulatory requirements. In addition, in the case of SMRs currently, under development, it is difficult to apply the current regulatory system based on the existing large light water reactors, and it is necessary to apply a number of exceptions, so it is considered necessary to improve the procedures to specify and systematically apply the current scope of regulatory requirements.

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