# Implementing Safeguards by Design: Analysis of Gaps and Suggested Amendments

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## 1. Introduction

The Republic of Korea (ROK) is currently one of the most active countries on nuclear related R&D and energy production. In order to utilize its nuclear energy infrastructure, the ROK is obliged to ensure compliance with international safeguards obligations as set out in the article 3 of Non-Proliferation Treaty (NPT). In this regard, the ROK and the International Atomic Energy Agency (IAEA) have entered into agreements, including the IAEA Comprehensive Safeguards Agreement (CSA) and the Additional Protocol (AP), with the aim of implementing safeguards on all nuclear material and facilities, thereby ensuring compliance with the stipulated requirements of the NPT [1].

The IAEA has recently introduced a proactive approach entitled Safeguards by Design (SBD), the aim of which is to integrate nuclear safeguards at the earliest stages of facility design, thus ensuring that facilities are built with safeguard mechanisms already in place [2], [3]. The purpose of SBD is to effectively reduce the risk of nuclear material diversion and mis-use of nuclear facilities. Traditionally, safeguards were implemented after the construction phase of nuclear facilities. However, the increasing levels of complexity inherent in nuclear safeguards requirements have led to a shift in perspective within the IAEA, with the organization now encouraging member states to incorporate safeguards from the initial design phase. This change is particularly relevant for emerging nuclear technologies, such as Small Modular Reactors (SMRs), which offer innovative approaches to nuclear power but also present new regulatory challenges [4].

Despite its status as the IAEA's SBD recommendation, the ROK's current nuclear regulatory framework does not fully reflect the principles of SBD. The existing Nuclear Safety Act does not mandate early engagement between regulatory authorities and facility operators, which may lead to potential compliance gaps.

This paper examines the legal challenges associated with implementing SBD in the ROK, and proposes specific legal amendments to align with international best practices.

# 2. The gap analysis between the IAEA Recommendations and the Republic of Korea's Legal System

The IAEA safeguards system is a series of measures designed to ensure that nuclear materials are not diverted

from peaceful uses and that nuclear facilities are only used for peaceful purposes. At various stages of the design and construction process, member states are obligated to submit a Design Information Questionnaire (DIQ) for new nuclear facilities to the IAEA, in accordance with the provisions of the CSA. The requirement for the submission of a revised version of the questionnaire arises whenever significant alterations are made to the design or construction of a nuclear facility, and the IAEA is required to receive these revisions.

The regulatory framework governing the licensing and operation of nuclear facilities within the ROK is delineated in the Nuclear Safety Act. However, from the perspective of safeguards, this Nuclear Safety Act does not necessitate the submission of a design information or DIQ to the safeguards regulatory authority (NSSC, Nuclear Safety and Security Commission) during the early design phase. This regulatory gap has the potential to impede compliance, particularly with new reactor designs such as SMRs. Currently, the ROK does not mandate facility operators to engage with safeguards regulatory authority until construction permits have been issued. In contrast, the IAEA recommend the progressive integration of safeguards from the conceptual design stage. This delay in engagement has the potential to increase the risk of costly design modifications at a later stage of the project.

# 3. Proposed Revisions to Regulatory Framework

NSSC Notification No. 2017-84, "Regulation on the Reporting of International Regulated Materials", should be amended to clarify the requirement for staged DIQ submissions. The "Regulation on the Reporting of International Regulated Materials" specify the content and deadlines for the design information, or DIQ, to be submitted to the IAEA during the design and construction phases of new nuclear facilities.

The licensing process for new nuclear facilities under the Nuclear Safety Act can be broadly divided into standard design approval, construction permit and operating license. At present, however, the timing of the submission of design information or DIQ does not correspond to the above licensing process. For example, the current timeframe for the submission of initial design information for new nuclear facilities is "within one month after the construction plan or construction permit is decided", which is not only unclear in meaning, but also does not correspond to "application for construction permit" or "approval of construction permit" as defined in the Nuclear Safety Act. Furthermore, the current Regulation do not include reporting requirements for design information related to the application for "standard design approval", which should be supplemented.

In addition, based on the current Regulation, after the construction permit is granted, the design information of the new nuclear facility is submitted to the safeguards regulatory authority. This is very late for applying safeguards measures from the early design stage. As mentioned in the previous section, the IAEA recommends that SBD be considered for new nuclear facilities. Therefore, to complement this, the Regulation should be revised to allow the submission of design information or DIQ at a relatively early stage in the design and construction of new nuclear facilities.

To address these issues, it is necessary to revised the design information and DIQ deadlines of the Regulation as follows to align them with the licensing procedures under the Nuclear Safety Act, as shown in the table 1. below.

Table 1. Proposed Revision of Design Information and DIQ Content and Reporting Deadlines

Facility	Report Type	Report Content	Reporting
Туре	1 . 51.	1 ··· ·	Deadline
New Facility	Preliminary Design Information Detailed Design	Initial stage design information on initial business plan, preliminary design, construction and operation start date, etc. Detailed and phased design	When submitting the "Standard Design Approval" or "Construction Permit" Confirming the approval of
	Information	information report based on preliminary design information	"Facility Site Application" or Upon receiving the "Standard Design Approval" certificate
	Initial Design Information Questionnai re	Outline design information questionnaire based on the construction plan in the format prescribed by the IAEA	When submitting "Construction Permit"
	Final Design Information Questionnai re	Detailed design information questionnaire based on the constructed design in the format prescribed by the IAEA	When submitting "Operating License"
Modificati on of Existing Facilities	Changes in Major Items of Design Information Questionnai re	Changes in major Items specified as prior notification in the facility attachment	When submitting of changes in major design information questionnaire
	Changes in Minor Items of Design Information Questionnai re	Minor changes not specified as prior notification in the facility attachment	Within 1 month after the completion of design information change

## 4. Conclusion

The adoption of the SBD is essential to ensure compliance with the IAEA's recent recommendation. The ROK is obliged to update regulations to facilitate the implementation of safeguards in a timely manner, enhance the efficiency of compliance and strengthen collaboration with the IAEA. The proposed amendment to the Regulation is designed to ensure that new nuclear facilities integrate safeguards at the earliest stage of the design process. The implementation of this reform is expected to enhance cooperation between the safeguards regulatory authority and nuclear facility operators through the establishment of structured consultation mechanisms. If the ROK adopts this legal basis amendment for the IAEA SBD, it will demonstrate that it is implementing the IAEA's advanced safeguards approach. It can be also providing a clear standard for submitting DIQ to the IAEA.

The results of this study will be reviewed by legal experts. The opinions of many stakeholders will be gathered through public hearings and other means. After that, we will work out the most appropriate final amendments to the regulations that all stakeholders can agree on. In other words, we will apply the amendment to the legal framework through these many efforts.

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