

A Study on the Regulatory Policy for the Application of Safeguards by Design

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1. Introduction

Research is currently under way in 2022 to introduce new nuclear facilities such as small modular reactors (SMR) and dry storage facilities for light-water reactor (LWR) spent fuel. Introduction of new nuclear facilities would require consideration and application of safeguards in advance.

Relevant South Korean regulations on safeguards aim to comply with obligations in accordance with the Comprehensive Safeguards Agreement (CSA) and Additional Protocol (AP), safeguard treaty with the International Atomic Energy Agency (IAEA), and Bilateral Treaty. According to the CSA, the State is to provide preliminary information on any new nuclear facility as soon as the decision is taken to construct, or to authorize the construction of the facility [1]. Therefore, there are many cases where application of safeguards is considered after the construction phase [2].

The Republic of Korea (ROK) has experience in construction and operation of dry storage facilities (i.e., Silos, MACSTOR/KN-400) for Pressurized Heavy Water Reactors (PHWRs) at the Wolsong Nuclear Power Plants (NPPs). When the MACSTOR/KN-400 was introduced, modifications were made through consultation with the IAEA on the application of safeguards at the design phase, which did not cause any difficulties in terms of construction and operation of the storage facility [3]. If discussions with the IAEA on application of safeguards at the design phase precede construction, design changes caused by safeguards after completion would not need to be considered. It is necessary to solidify the legal basis for safeguards by design (SBD) stipulated in the Nuclear Safety Act (NSA) as a mandatory requirement rather than a recommendation, so IAEA obligations can be smoothly executed at the design phase.

In this study, we analyze case studies of other countries and the safeguard regulations system in ROK to apply SBD to new nuclear facilities so as to suggest directions for complementary policies.

2. Current Status on Safeguards

The regulatory requirements relevant to safety and security of new nuclear facilities have been clearly stated. However, regulatory requirements on safeguards, such as nuclear material accounting, containment, surveillance, and inspection, are focused on nuclear material verification. The requirements on containment, surveillance methods, and safeguard application

procedures should be clear so that safeguards can be efficiently applied into facility designs. To this end, each phase of design and construction would necessitate feedback on design information.

SBD considers safeguards from the conceptual design phase of new nuclear facilities, enabling effortless implementations of the IAEA safeguards. The IAEA recommends application of SBD to lighten the burden of facility operation and carrying out of effective safeguards.

2.1 International Safeguard Mandatory Requirements

Relevant South Korean regulations on safeguards aim to comply with obligations in accordance with the CSA and AP, safeguard treaty with IAEA, and Bilateral Treaty.

The time limits set to provide design information for the IAEA in accordance with the INFCIRC/153(Corr.) should be imposed based on subsidiary agreements between the State and the IAEA. Safeguard obligations at the design and construction phase are as follows [1];

- Provision of preliminary design information for new facilities immediately the decision to construct or authorize construction has been taken, whichever comes earlier.
- Provision of further information on developing designs of new facilities.
- Provision of completed agency design information questionnaires (DIQ) for new facilities based on preliminary construction plans as early as possible, and in any event not later than 180 days to the start of construction.
- Provision of completed DIQ for new facilities based on "as-built" designs as early as possible, and in any event not later than 180 days before the initial reception of nuclear materials at the facility.

As are shown in the aforementioned provisions, provision of design information, DIQ, and continual updates are mandatory requirements during design development and construction progress. Design information will be used to apply safeguards such as containment, surveillance, and safety procedures.

2.2 Research on application of SBD in countries other than ROK

According to Pacific Northwest National Laboratory (PNNL)'s commercial NPPs safeguards implementation review, many reactor designs involving U.S., European licensure including nuclear weapons states, have relatively few safeguards requirements. Therefore, it has

become standard practice to simply apply at the design phase and consider specific design for safeguards at the construction phase [4]. It is typical for design information to be furnished to the IAEA 180 days before fuel loading at a reactor site [4]. This approach satisfies the INFCIRC/153 provision stipulated in section 2.1, but shows that the application of SBD from conceptual design phase is limited.

The Idaho National Laboratory (INL) put forward a project flow shown in Fig. 1. for the successful implementation of SBD [2] from pre-conceptual design to construction of a nuclear facility.

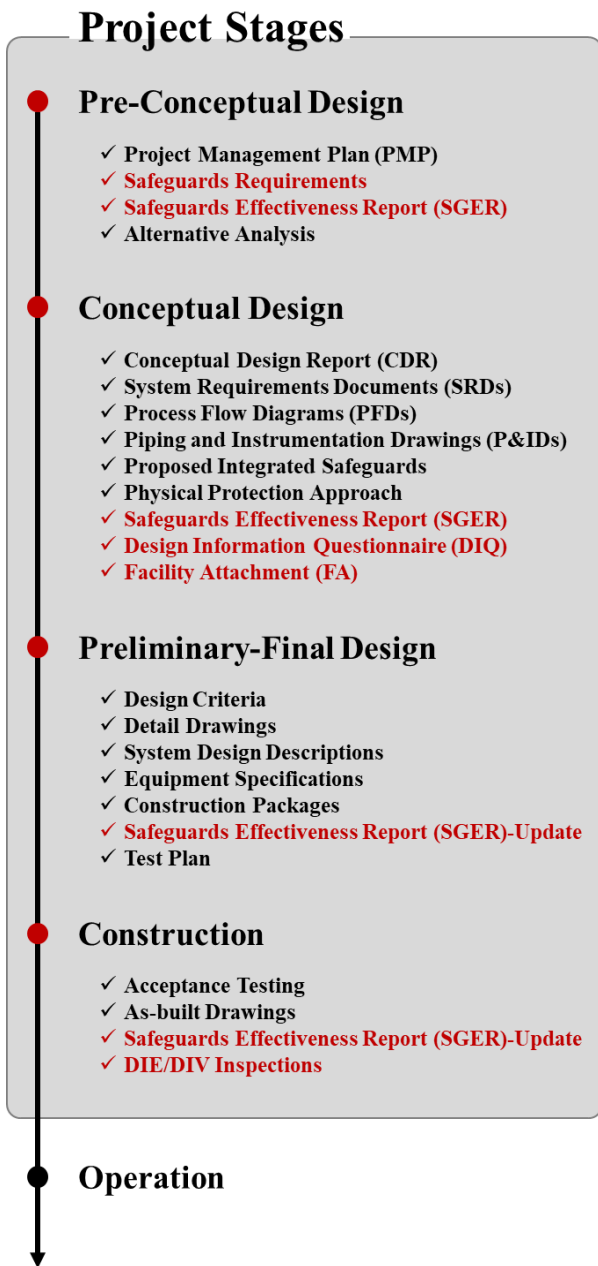


Fig. 1. Project flow diagram nuclear facility [2]

The project flow diagram above shows that application of SBD should be considered during all

phases from pre-conceptual design to the construction of a nuclear facility.

3. Methods to Apply SBD Regulations in ROK

The ways to apply SBD regulations in ROK can be stated as follows.

First, major SBD items that should be applied to a new nuclear facility should be stipulated so that the safeguards are considered during the design phase.

Second, time limits for providing the design information of a new facility should be imposed.

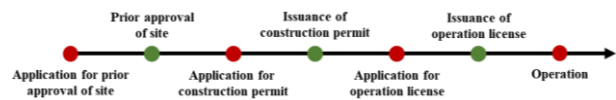


Fig. 2. Approval steps in ROK

Fig. 2. shows the licensing phases in ROK. In accordance with Article 98 Clauses 1, 2, and 4 of the NSA provisions and reports on internationally controlled goods under the Nuclear Safety and Security Commission (NSSC), design information and design information questionnaires of new nuclear facilities should be submitted, and audit on the business place should be implemented after the issuance of construction permit. A legal basis of public notice should be created and discussions on SBD should be conducted at the application phase before approval of sites and application for construction permit.

Lastly, discussions on SBD should be held among parties of the IAEA, business owners, and the government. The aforementioned content should be established as mandatory requirements in the safeguard regulations system of ROK.

4. Conclusions

We reviewed the application of safeguard relevant regulations in ROK for the introduction of new nuclear facilities, of which research is under way. We recognized the need to create a legal basis for the application of SBD from studying the construction of a dry storage facility.

We analyzed the CSA and AP, and compiled the safeguards relevant regulations during design and construction phases of nuclear facilities. We checked cases of other countries regarding the provision of design information for safeguards and the list of documentation per phase for application of safeguards at the design phase.

We are supplementing the SBD regulations system in ROK, where the installation and implementation procedures of safeguards can be applied from the design phases of new nuclear facilities. A legal basis should be laid for fulfilling the IAEA requirements at the design and construction phases. We analyzed issues on the provision of design information in association with SBD

application regulations and suggested a direction of statute revision by stating a proper time limits for provision.

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