Comparative Study on NPP Commissioning and Operation Requirements between IAEA and Korea

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1. Introduction

The IAEA safety standards encompass international consensus to strengthen the nuclear safety and to reflect the latest advancement of safety regulation related to technologies. Also, they provide a reliable means to ensure the effective fulfillment of obligations under the various international safety conventions. Many countries have adopted the IAEA safety standards as their national standards in nuclear regulations. And Korea has exported nuclear power plant technologies abroad these days.[1]

The KINS (Korea Institute of Nuclear Safety) has performed a review of the IAEA safety requirements for the commissioning and operation of NPPs(Nuclear Power Plants) [2] comparing with those of Korea. The purposes of this comparative study are to harmonize the commissioning and operation safety requirements for the NPPs of Korea with those of the IAEA as a member state of the IAEA, and to encompass global efforts to enhance the nuclear safety and to reflect the latest advancement of safety regulation related technologies into the commissioning and operation safety requirements for the NPPs of Korea. Commissioning and operation requirements for structures, systems, and components of NPPs as well as for procedures and organizational processes important to safety, which are required to be met for assuring safe operation, for preventing events that could compromise safety, or for mitigating the consequences of such events, have been reviewed in this study.

2. Methods

The comparative review was performed to identify the gap of the safety requirements for the commissioning and operation of NPPs between the IAEA and Korea. Based on the review results, draft revision of domestic safety requirements were developed to fill the gap.

2.1 Review Method between IAEA and Korea Safety Requirements for commissioning and operation of NPPs

The IAEA safety standards have three categories: Safety Fundamentals, Safety Requirements, and Safety Guides (see Fig. 1). Safety Fundamentals present safety objectives and principles, and provide the basis for the safety requirements. Safety Requirements provide the requirements that must be met to ensure the safety. Safety Guides contain recommendations and guidance on how to comply with the safety requirements.

The IAEA safety standards series No. SSR-2/2, "Safety of Nuclear Power Plants: Commissioning and Operation" [2] provide the requirements to be met in commissioning and operation of NPPs. It belongs to the category of Specific Safety Requirements in the hierarchy of the IAEA safety standards (see Fig. 1). The level of detail of the requirements of the IAEA No. SSR-2/2 is similar to that of technical standards, notices of NSSC (Nuclear Safety and Security Commission), and regulatory standards of Korea.

In this study, the commissioning and operation safety requirements of the IAEA were reviewed comparing with those of Korea aforementioned above in the aspects of the following:

- Completeness of regulatory topics addressed by safety requirements;
- Level of safety achieved by safety requirements; and
- Scope and depth of regulatory positions provided by safety requirements.

Fig. 1. Safety standards hierarchy of IAEA and Korea

The domestic regulatory documents used for the comparison are as follows:

- Regulations on technical standards for nuclear reactor facilities, etc;
- Regulations on technical standards for radiation safety control, etc;
- Notices of nuclear safety and security commission; and
- Regulatory standards for LWR nuclear power plants

3. Results

There are 24 items and 207 paragraphs in the safety requirements of the commissioning and operation of NPPs of the IAEA. All the requirements of the IAEA for the commissioning and operation of NPPs have been reviewed comparing with those of Korea and it was found that there exist gaps in 24 safety requirement items.

The gaps of safety requirements of commissioning and operation for NPPs between the IAEA and Korea found in this study were classified into 3 groups: requirements for strengthening safety, improving regulatory requirements, and improving completeness of regulatory documents. The safety requirements of the IAEA that show differences with those of Korea are explained in the below.

3.1 Strengthening of safety

The safety requirements of the IAEA that shows differences in the level of safety through the gap analysis are as follows:

- Probabilistic safety assessment shall be used, as appropriate, to demonstrate that the risks are not significantly increased during maintenance work.

3.2 Improvement of regulatory requirements

The following requirements were derived to improve regulatory requirements of Korea:

- No commissioning tests are performed that might place the plant in an unanalyzed condition. And a review of the test results for each stage shall be completed before commissioning is continued to the next stage.
- The chemistry programme shall be developed prior to normal operation and shall be in place during the commissioning programme about chemistry monitoring, measuring and recording of chemistry data, alarms for relevant chemistry parameters, control of chemicals.
- Establish and implement arrangements to ensure the effective performance for outage management, priority about safety, information sharing of current activities for maintenance, modification and testing
- A human resource programme, multiple unit plant provision, decommissioning plan

3.3 Improvement of completeness of technical standards of Korea

Some safety requirements of the IAEA were identified to improve the completeness of the current technical standards of Korea by stipulating the regulatory practices of Korea and by reflecting the safety requirements of the IAEA. Such safety requirements identified in this study are as follows:

- A commissioning programme for the plant is established and implemented. A comprehensive process shall be established to address non-conformities in design, manufacturing, construction and operation.
- Operating procedures and test procedures shall be verified to ensure their technical accuracy and shall be validated to ensure their usability with the installed equipment and control systems.
- The habitability and good condition of control rooms shall be maintained. The control components related safety shall be kept operable. The alarms shall be managed as an important feature in operating a plant safely.
- To develop and implement programmes to maintain a high standard of material conditions, housekeeping and cleanliness in all working areas.
- The frequency of maintenance, testing, surveillance and inspection of individual structures, systems and components shall be determined on the basis of consideration. New approaches that could result in significant changes shall be taken only after careful consideration of the implications for safety and after appropriate authorization.

Also, in order to improve the completeness of the technical standards of Korea, the following safety requirement items were identified, which should be added in “Regulations on Technical Standards for Nuclear Reactor Facilities, Etc.” [3]: scope of commissioning plan, support system of operation, handing of core and fuel, reactivity control plan & core monitoring plan, and etc.

4. Conclusions

This study was useful to identify the gap between the safety requirements for commissioning and operation of NPPs of the IAEA and Korea. The review results will be utilized to reflect the IAEA safety requirements into those of Korea, which will contribute to enhancing the level of nuclear safety and improving the technical standards of Korea.

REFERENCES

[1] Won Joon Chang, et al, “Comparative Study on NPP Design Requirements between IAEA and Korea”, 2012 Autumn KNS, 2012.
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