

## Comparative Study on Research Reactor Operation Requirements of IAEA and Korea

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### 1. Introduction

Safety requirements for the nuclear power plant (NPP) are applied to the regulation of the research reactor in Korea since safety requirements are not established for the research reactor. The IAEA has developed safety requirements No. NS-R-4 "Safety of Research Reactors" [1], which is safety requirements for the research reactor. The IAEA safety requirements represent a consensus view of the IAEA's member states and encompass the recommendations of international experts for the safety of the research reactor. The IAEA safety standards are acknowledged as a global standard by most countries in the world. Therefore, it is desirable to harmonize domestic safety requirements with those of the IAEA. Also, since the IAEA safety requirements include international endeavors to strengthen nuclear safety and to apply the latest nuclear safety technologies to nuclear facilities, a comparative analysis of the safety requirements of the IAEA and Korea for the research reactor will be beneficial to obtaining the insights to improve regulations of the research reactor in Korea. For the reason, a comparative study has been conducted for the research reactor operation safety requirements of the IAEA and Korea in this paper. This paper briefly introduced operation safety requirements in the NS-R-4, analysis methods of this study, and the analysis results.

### 2. Analysis Methods

In this study, a comparative analysis has been performed to identify the gaps between the IAEA operation safety requirements of the NS-R-4 and those of Korea for a nuclear power plant (NPP).

Fig. 1 shows the hierarchy and tiers of the IAEA safety standards.

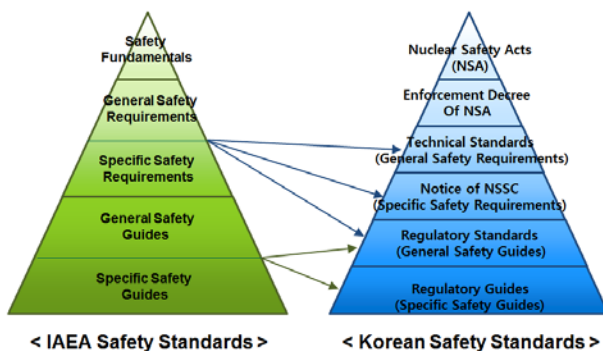


Fig. 1. Hierarchy of safety standards of IAEA and Korea [2]

The NS-R-4 belongs to the tier of specific safety requirements, which establish the requirements for specific nuclear facilities or for specific nuclear activities that must be met to ensure the protection of people and the environment. The NS-R-4 includes research reactor operation safety requirements for the following areas: organization, training, technical specifications, commissioning, operating procedures, inspection/testing/ maintenance, core management and fuel handling, fire safety, emergency planning, physical protection, records and reports, utilization and modification of the reactor, radiation protection, safety assessment and ageing related aspects, and extended shutdown. These requirements are presented in Art. 7.1- 7.112 of the NS-R-4.

The level of detail and the contents of the requirements specified in the NS-R-4 correspond to those prescribed in the following domestic regulatory documents:

- Regulations on technical standards for nuclear reactor facilities, etc. [3];
- Regulations on technical standards for radiation safety control, etc. [4];
- Notices of nuclear safety and security commission (NSSC); and
- Regulatory standards and guides for LWR nuclear power plants [5].

The operation safety requirements for the research reactor in the NS-R-4 were compared with those applied to the research reactor in Korea in order to identify the gaps in the safety requirements between the IAEA and Korea in the following aspects:

- Completeness of regulatory topics covered by the entire safety requirements;
- Level of safety achieved by safety requirements; and
- Scope and depth of regulatory positions provided by individual safety requirements.

### 3. Results

The 112 operation safety requirements for the research reactor in the NS-R-4 have been compared with those for the NPP of Korea.

The results show that there exist some gaps between the IAEA operation safety requirements for the research reactor and those for the NPP of Korea. The followings present the major gaps identified in this study.

- Safety assessment: the IAEA safety requirements for the research reactor require that periodic safety

assessment shall be performed for all safety related aspects of operation, including radiation protection, site re-evaluation, physical protection, and emergency planning, throughout the operating lifetime of research reactors. In Korea, periodic safety assessment is not applied to the research reactor.

- Categorization of the utilization and modification of the research reactor: the IAEA safety requirements for the research reactor require that the categorization criteria for the utilization and modification of the research reactor shall be established according to the safety significance of the proposals for the utilization and modification. Also, they require to conduct safety analysis for the utilization and modification, and to develop procedures for experiments considering the effects of the experimental facilities on the reactor safety. Domestic operation safety requirements do not cover the utilization of the research reactor since the safety requirements for the NPP are applied to the research reactor in Korea.
- Safety measures during an extended shutdown: a research reactor facility may have a period of extended shutdown owing to pending decisions on its future, budgetary consideration, a lack of utilization, or equipment failure [1]. The IAEA safety requirements require that appropriate measures shall be taken during an extended shutdown to ensure that materials and components are not seriously degraded. Domestic safety requirements for the NPP do not deal with this requirement since the issue during an extended shutdown is not a concern of the NPP.
- Consideration of experimental devices in the commissioning program: the IAEA safety requirements require that experimental devices shall be considered adequately during the commissioning of the reactor. Domestic safety requirements for the NPP do not consider the experimental devices in the commissioning program.
- Measures for changes from the normal reactor configuration: the IAEA safety requirements require that procedures for inspection, periodic testing, and maintenance shall include the measures to be taken for any changes from the normal reactor configuration and the provisions for the restoration of the normal configuration on the completion of the activity of the inspection, periodic testing, and maintenance. This requirement resulted from operating experiences of the human errors in such activities, which is not yet incorporated in the domestic safety requirements for the NPP.
- Responsibility for safety of operating organization: the IAEA safety requirements require that the operating organization shall have the overall responsibility of the research reactor, which shall not be delegated to other organization. This requirement is not specified in the domestic safety requirements for the NPP.

- Frequency adjustment of inspection, testing, and maintenance: the IAEA safety requirements require that the frequency of inspection, testing, and maintenance of structures, systems, and components shall be adjusted on the basis of operating experience and shall be such as to ensure adequate reliability. This requirement is under consideration but not yet adopted in safety requirements of Korea.
- Emergency planning: the IAEA safety requirements require that the emergency plan and arrangements shall include guidance on limits on the doses due to exposure of personnel performing rescue missions or missions to mitigate the consequences of an emergency. This requirement is not specified in the domestic safety requirements but is applied to the domestic regulation as a practice.

#### **4. Conclusions**

A comparative study has been performed on research reactor operation safety requirements of the IAEA and Korea. This study has identified some gaps in operation safety requirements for the NPP of Korea, comparing with those for the research reactor of the IAEA in the following areas: periodic safety assessment, utilization and modification of the reactor, extended shutdown, inspection/testing/maintenance, operating organization, emergency planning, and commissioning. The analysis results show that the gaps resulted mainly from the following aspects:

- The differences in the design and operation between power and research reactor,
- Enhancement of the safety level of the IAEA safety requirements, and
- Consideration of operating experiences in the IAEA safety requirements.

It will be of benefit to reflect the analysis results identified in this study into the domestic safety requirements, which will contribute to enhancing the safety level and improving the regulation of the research reactor in Korea.

#### **REFERENCES**

- [1] "Safety of Research Reactors", Specific Safety Requirements, IAEA Safety Standards, No. NS-R-4, IAEA, 2005.
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