Transactions of the Korean Nuclear Society Spring Meeting
Chuncheon, Korea, May 25-26 2006

Regulatory System for Research Reactors in Foreign Countries

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1. Introduction

Two kinds of research reactor are operating now in Korea. One is HANARO (Open pool type, 30 MW_{th}) in KAERI and the other is AGN-201 (HOMOG(S), 0.1W_{th}) in Kyung-Hee University.

Because of the low power level, the small number and the size of the research reactors, the upgrading of domestic regulatory system for those facilities has not been so much concerned as the power plants. Recently, a study related to the SMART-P which is designed for the research and development was performed. In that study, licensing process and technical requirements for non-power reactor were investigated generally. In this study, the latest status of the regulatory system for research reactor in the countries, such as the United States of America, France, Germany, the United Kingdom and Japan, are surveyed with comparing to that for power plants. The results of survey will be useful to find directions of enhancement in our own system.

2. Regulatory System for Research Reactors in Foreign Countries

2.1 United States of America

The regulations in Title 10 of the Code of Federal Regulations define research and power reactors. Power reactor means a nuclear reactor designed to produce electrical or heat energy licensed by the Commission under the authority of section 103 or subsection 104b of the Act and pursuant to the provisions of § 50.21(b) or § 50.22 of this chapter.

Reactors that are not power reactors are referred to as non-power reactors in the regulations. Non-power reactors include research reactors and test reactors (called testing facility in some regulations). Non-power reactor means a research or test reactor licensed under §§ 50.21(c) or 50.22 of this part for research and development.

Research reactor means a nuclear reactor licensed by the Commission under the authority of subsection 104c of the Act and pursuant to the provisions of § 50.21(c) of this chapter for operation at a thermal power level of 10 megawatts or less, and which is not a testing facility as defined by paragraph (m) of this section.

Testing facility means a nuclear reactor which is of a type described in § 50.21(c) of this part and for which an application has been filed for a license authorizing operation at:

(1) A thermal power level in excess of 10 megawatts; or
(2) A thermal power level in excess of 1 megawatt, if the reactor is to contain:
(i) A circulating loop through the core in which the applicant proposes to conduct fuel experiments; or
(ii) A liquid fuel loading; or
(iii) An experimental facility in the core in excess of 16 square inches in cross-section.

NRC's regulations have been specifically established to consider the lower risk of research and test reactors compared to power reactors to ensure an acceptable level of safety for all NRC-licensed activities. These licenses include authorization for operation, and possession of radioactive material. Licensing actions include license renewals, extensions, authorizations for decommissioning, license terminations after completion of decommissioning, conversions to low-enriched uranium fuel, and power upgrades. Test reactors, with their higher power levels follow a more complex licensing process than research reactors. For example, for the initial licensing of a test reactor and a power reactor, the staff is required by the regulations to prepare an environmental impact statement. An environmental impact statement is not required for research reactors.

Technical safety standards follow a graded approach. Many of the technical safety standards that are applied to power reactors are not applicable to research and test reactors because of the difference in operating parameters. For example, 10 CFR 50.60, "Acceptance criteria for fracture prevention measures for lightwater nuclear power reactors for normal operation," does not apply to research and test reactors because these reactors run at low pressures and temperatures which do not challenge the coolant pressure boundary. NUREG-1537 discusses the applicability of some of the regulations to research and test reactors.

The regulatory process and technical safety standards that research and test reactors follow are outlined in NUREG-1537, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors" (available at the NRC website under accession numbers ML042430048 and ML042430055). The regulatory approach to research and test reactors uses a graded approach where the complexity of the licensing process, technical safety standards and regulatory inspection process increases from research reactor, to test reactor, to power reactor as the risk the reactor poses increases.

The NRC also uses a graded approach in its inspection program. Because they pose a lower risk than power reactors, inspections at research and test reactors occur less frequently than inspections at power reactors.

The inspection program for operating research and test reactors includes review of operational activities, design control, review and audit functions, radiation and environmental protection, operator requalification, maintenance and surveillance activities, fuel handling, experiments, procedural controls, emergency preparedness, transportation, security, and material control and accounting. The inspection program also encompasses a review of organizational structure and qualifications and responsibilities of reactor personnel. If the inspection program identifies violations of requirements, the NRC takes appropriate enforcement action. The NRC Inspection Manual Chapter 2545 contains the guidance which the

NRC uses to administer the Research and Test Reactor Inspection Process. Manual Chapter 2545 and research and test reactor inspection procedures can be found on the NRC's public web site.

2.2 France

In France, there is no legal distinction between power reactors and research reactors since they are both legally defined as Basic Nuclear Installations (BNI) and are subject to the two same types of regulations such as licensing procedures and technical rules.

The licensing procedures are defined by decree 63-1228 of 11 December 1963 and apply equally to nuclear power plants and to research reactors. This decree notably provides for an authorization decree procedure followed by a series of licences issued at key points in the plant's lifetime: fuel loading or pre-commissioning stages, commissioning, final shutdown, dismantling. The technical nature of the BNI is mentioned in the authorization decree.

The general technical regulations, based on article 10a of the previously mentioned decree of 11 December 1963, currently cover four major subjects: pressure vessels, quality organization, BNI water intake and effluent release and external hazards and detrimental effects related to BNI operation. Some new orders are on preparation. The orders apply to all BNI.

The Nuclear Safety Authority (ASN) also issues Basic Safety Rules (RFS) on various technical subjects, concerning both PWRs and other BNIs. These rules constitute recommendations defining the safety aims to be achieved and describing accepted practice the ASN deems compatible with these aims. There are currently about forty Basic Safety Rules. They are not, strictly speaking, regulatory documents. Rules laid down in this context are particularly flexible, allowing for technical advances and new know-how, and may apply specifically to power reactors or to BNIs other than power reactors (e.g. RFS on the confinement).

The regulatory inspection is of the same nature for both types of BNIs.

2.3 Germany

In Germany, research reactors primarily are supporting fundamental research and research in material sciences.

Depending on the particular reactor design, medical treatments may be possible, as e.g. in case of FRM II.

All of the German research reactors according to app. 2.1 - 2.3 of the Report do not have a turbine to produce commercial electricity.

The safety standards on which licensing in case of research reactors is based, do not differ from the ones for power reactors, in fact they are the very same ones. They are implemented in licensing for research reactors according to applicability, only very few regulations are made particularly for research reactors (e.g. KTA 1507).

This approach is different from the approach taken for the IAEA Standards, where research reactors and power reactors follow their own standards respectively.

Licensing procedure and inspections shall be adequate to the risk imposed by the individual research reactor. In case of the FRM II, finally licensed for operation in 2004, the procedure and the requirements were very similar to the ones for power reactors.

2.4 The United Kingdom

In the United Kingdom, there are no specific criteria to differentiate between the two categories of reactor. Research Reactors must comply with exactly the same licence conditions as power reactors.

They are also subject to the same licensing procedures, must comply with the same safety standards and are subject to the same regulatory inspection program.

Usually, because of the physical size and generally lower hazard the regulatory process on research reactors is less intensive.

2.5 Japan

Power reactor means any reactor that generates the electricity using the heat generated by the reactor. Research reactor means any reactor that is used for research, testing and other reactors than those not used for power generation. In Japan, the regulation of reactors is based on the Reactor Regulation Law.

Power reactors are regulated by NISA, research reactors are regulated by the Nuclear Safety Division, Office for Nuclear Regulation, Science and Technology Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology (MEXT).

The regulatory procedure for both type of reactors are basically similar. For research rectors, regulation during establishment stage, construction stage and operation stage is conducted with Article 23 (Establishment of Reactor), Article 24 (Criteria for Approval), Article 28 (Pre-Service Inspection), Article 28-2 (Welding Methods and Inspection), Article 29 (Periodic Facility Inspection) and Article 30 (Operation Plan) of Reactor Regulation Law, as is the case of power reactors.

The detailed rules and technical criteria were provided and enforced by MEXT.

3. Conclusion

The regulatory systems for research reactor of The United States of America, France, Germany, the United Kingdom and Japan are surveyed. Various different features of licensing process and regulatory requirements are found. Regulatory systems for research reactor in United State of America and Japan are appeared to be more distinguishable than those of other countries with a graded approach and uses of research reactors.

Specially, in this study, it is found that a periodic safety review for the operating research reactors as well as power plant is implemented in accordance with legal requirements in Europe countries and Japan.

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