Introduction to Safety Classification for Nuclear Facilities in Germany

KyungJun Kang [a*], YongHwan Yoo [a], Yongse Kwon [a], SangIk Wu [a], JunYeon Kim [a], Minjin Kim [a]
[a]*Reactor Project Engineering Division, Korea Atomic Energy Research Institute,989-111 Daedeok-daero, Yuseong-gu, Daejeon, 305-353, Korea*
[*]*Corresponding author: kkj@kaeri.re.kr*

1. Introduction

Several European nations apply Germany's regulation for nuclear facilities such as the safety classification, codes and standards because Germany has a lot of practical experience in nuclear plant and has made nuclear regulations to be developed on the basis of them. This paper is to broadly introduce their regulation framework and additionally summarize an overview or the safety classification of systems, structures and components (SSCs) for German nuclear facilities.

2. SSCs Safety Classification

2.1 Regulation Framework for Nuclear Facility in Germany

The general hierarchy of the German regulations is laid down as follows; Atomic Act (Atomgesetz), Radiation Protection Regulation, BMI- Safety Criteria and Guidelines of the Nuclear Reactor Safety Commission, Design Rules of the Nuclear Technology Comity(KTA-rules), Conventional Standards (DIN/EN, TRD, AD 2000 etc). Figure 1 shows the structure of the licensing process, regulatory body, and their support organizations.

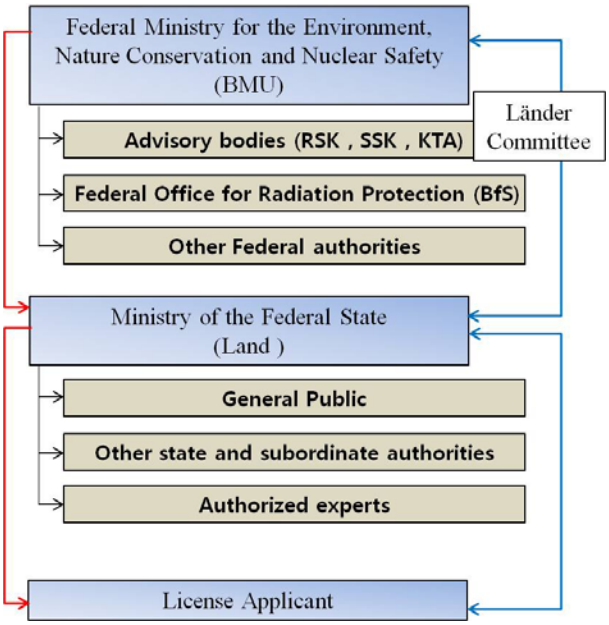

Fig. 1 Structure of licensing process and regulatory frame in Germany

The BMU as a Federal Ministry has regulatory authority and responsibility on nuclear safety and radiation protection. In addition, it has the competence to implement oversight lawfulness and expediency of actions of Länder. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) prepares regulatory guidelines such as safety criteria, accidents and other guidelines and recommendations. Länder government authorities have a role to grant licenses and approvals, controls and inspections in the nuclear facility assessments with regard to the relevance to the safety.

The licensing process for nuclear facilities in Germany involves many federal and local authorities including authorized expert organizations. The BMU asks the Reactor Safety Commission(RSK) and the Commission on Radiological Protection (SSK) for advice on important issues related to licensing and supervisory procedures, development of rules and regulations or safety research. Depending on the issues to be discussed, Länder authorities, plant operators or the industry also is involved. KTA safety standards are not legally binding. However, owing the nature of their origin and their high degree of detail, they have a practical effect. Conventional technical rules apply to the construction and operation of nuclear installations. This is particularly the case for the national standards of the German Institute for Standardisation (DIN) and the international standards of ISO and IEC.

2.2 SSCs Classification Process

Concept of safety and protection aims in Germany focuses on control of reactivity, cooling of nuclear fuels, Inclusion of radioactive material and Limitation of radiation exposure. The basis for SSCs classification of nuclear facilities is according to those of IAEA (Draft DS367). The basis of Structures, Systems and Components (SSCs) classification of NPP was according to those of IAEA as follows; Step 1). The functions important to the safety of the systems, structure and components of a NPP shall be defined and the SSCs classified according to their safety significance; Step 2). The systems, structures and components important to safety shall be designed, manufactured, installed and operated so that their quality level and the inspections and tests required to verity their quality level are adequate considering any item's safety significance.

To comply with the mentioned principles, the SSCs of NPP are grouped into Safety Classes 1, 2, 3, 4 and Class NNC (Non Nuclear Component). The items with the highest safety significance belong to Safety Class 1.

2.3 Safety Classes, Quality Classes and Methodology

For the construction, operation, safe enclosure and dismantling of facilities or installations, the limits of the radiation exposure of individual members of the general public is along the German Radiation Protection Ordinance and ICRP. Safety Class determines what quality requirements apply to the NPP systems, structures and components and to their quality assurance. The plant owner for a construction or operation license shall define how safety class and quality requirements on one side and safety class and quality assurance on the other side are interrelated. The scope of the regulatory control of SSCs is determined by the safety class. The regulatory control of systems based on safety classification must to be described in special documents. The inspections and control practices for structures and components in Safety class K1, K2, K3, K4 and K5 for NPP are described normally in the codes and standards or in special technical specifications. Safety class K1 for NPP is applied to primary safety functions as mentioned in section 2.2.

Figure 2 indicates the safety classification of NPP and FRM II which is reference research reactor for benchmarking. The safety requirements related with K1 is specified and defined in KTA standard 3201. Also, the criteria for documentation during the construction and operation is along KTA standard 1404 and the general requirements regarding quality are described in KTA standard 1401. ASME Sect. III NB is applied to the quality requirements, design and fabrication of SSCs corresponding to safety class K1. As that of safety class K1, safety class K2 is determined along KTA standards 3211 which considered in auxiliary systems connecting to the primary circuit. KTA standard 3211 includes the material selection, design guideline, construction, calculation, fabrication and inservice inspection for safety class K2 SSCs. K3 corresponds to auxiliary systems to perform functions as radioactive protective measure. K4 is not related with safety functions. Detailed codes and standards for safety class K3 and K4 are ASME Sect. III ND for quality requirement, DIN EN standards for fabrication. The reference research reactor for the SSCs Classification example is FRM-II. Because FRM-II is a research facility, there is no SSCs class equivalent to K1 for NPPs. FRM safety class FK1 is equivalent to K2 for NPP. The main functions of SSCs corresponding to FK1 and FK2 are to holdup and isolate a radioactive material and remove core heat, maintain sub-critical reactor condition and sufficient reactor coolant inventory for core cooling and provide radiation shielding.

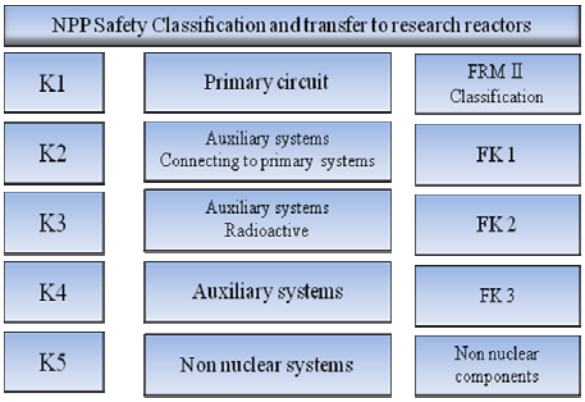

Fig. 2 NPP safety classification and relation to research reactor FRM II

3. Conclusions

The safety classification of Germany depends on the safety function of SSCs. It is determined along the radiological limits by Radiation Protection Regulation, criteria of KTA standards and industrial codes and standards including ASME or domestic rules. Safety class K1 for NPP is definitely corresponding to safety class 1(SC1) of IAEA. Safety class K2 may involve SSCs related to SC2 and SC3 of IAEA. Safety classes below K3 for NPP or FK2 for RR may be correspond to NNS of IAEA and more specifically subdivided than NNS of IAEA along Germany's quality requirements.

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