

Research on the General Framework of the Construction of Nuclear and Radiation Safety Standard System in China

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Abstract. In this paper, the general framework and suggestion for the construction of China Nuclear and radiation safety standard system are put forward. The relationship of nuclear and radiation safety standards with the relevant laws and regulations is discussed. The status quo, existing problems and requirements of nuclear and radiation safety standard are analysed in China. The research work has laid a foundation for the establishment and improvement of China's nuclear and radiation safety standards system, and has made a useful exploration.

1. Introduction

It is well known that nuclear accidents and radioactive pollution will endanger the staff, public health and environment, and will bring lasting and deep-going impacts. The National Nuclear Safety Administration (NNSA) statistics show that up to the end of December 2016, there are 35 nuclear power units in operation, 21 nuclear power units in the construction, and 19 civilian nuclear research reactors (critical device). In addition, 21 civilian nuclear fuel circulation facilities are under construction or under construction [1]. China's nuclear safety and environment are facing challenges. There is no complete and good standard system for nuclear and radiation safety in China also. The result is that these standards are scattered, the level and relationship between them are not clear, and looks messy. These problems have negative effects on China's nuclear and radiation safety supervision, and have restricted the efficiency of safety supervision. After the Fukushima nuclear accident in Japan, international community and the industry require stricter standards to ensure safety. China urgently needs to establish a scientific and reasonable nuclear and radiation safety standard system (NRSSS) as soon as possible. .

The preliminary design scheme of framework of NRSSS for China is put forward in this paper, and the construction principle and structure level of NRSSS are discussed. In general, we can consider the framework and construction of NRSSS from the following aspects.

2. The Purpose and Principle of NRSSS Construction

The purpose of establishing NRSSS should be to provide technical support for nuclear safety supervision and review, and provide guidance for the standardization work of nuclear and radiation safety. The construction of NRSSS should fully embody the principles of integrity, systematicness, hierarchy, science and coordination.



3. The validity, status and hierarchy of nuclear and radiation safety standards

In China, standards and laws fall into two different categories respectively. Laws and regulations are produced by legislative bodies, which are composed by National People's Congress or its authorized departments, and issued by the president of the People's Republic of China, the State Council or its subordinate departments. They are for people, including legal and natural persons, focus on the management content. While standards are formulated and published by the organization of standardization, a standard is the uniform provisions of a certain range of repetitive things and concepts, providing rules for the parties to reuse, focusing on technical content. According to the management requirements of China's standardization law, standards are divided into mandatory and recommended, and mandatory standards have regulatory status, similar to technical regulations. According to the administrative provisions of the standardization law of China, the standards are divided into two categories in China: mandatory standards and recommended standards, and mandatory standards have regulatory status, equivalent to technical regulations.

China's legal system is a "Pyramid" structure consists of state laws, regulations, departmental regulations and local laws and regulations. It is a multi-level structural system of Pyramid type. While China's standard system is also a "Pyramid" structure. It is made up of national standards, industry standards, local standards and enterprise standards.

The relevant laws and regulations of China have given nuclear and radiation safety standards a certain degree of legal effect and status [2]. For example, the nuclear safety law of the People's Republic of China stipulates that the state adheres to the establishment the nuclear safety standard system from high to severe. Nuclear safety standards are mandatory standards. Other laws have also made corresponding provisions, such as the law on the prevention and control of radioactive pollution, the regulations on the supervision and administration of the safety of civilian nuclear installations, and so on.

Compared with the general industrial standards, the nuclear and radiation safety standards are the refinement and implementation of the requirements of nuclear safety regulations, the technical provisions of compulsory enforcement, and the embodiment of the will of the state.

Therefore, this study suggests that nuclear and radiation safety standards should include mandatory standards and recommended standards, of which the mandatory standards should be for national standards (GB), formulated by the Ministry of environmental protection (National Nuclear Safety Administration, NNSA) and issued jointly by NNSA and China National Standards Committee, binding, the equivalent of technical regulations. The recommended standard includes the recommended national standards (GB/T) and the national environmental protection standard (HJ), of which the GB/T standards formulated by NNSA and issued jointly by NNSA and China National Standards Committee, and the HJ standards formulated and promulgated by NNSA.

As of August 31, 2017, the total of currently valid nuclear and radiological safety standards of the Ministry of environmental protection (National Nuclear Safety Administration) is 95, of which 32 are GB standards, 39 are GB/T standards, and 24 are HJ standards [3].

4. Framework composition of NRSSS

In China, there is more than a dozen professional fields involved in national nuclear and radiation safety supervision, including nuclear power plants, research reactors, nuclear fuel cycle facilities, radioactive waste disposal and control of nuclear materials, civil nuclear safety equipment, radioactive materials transportation, radioisotope and irradiation devices, electromagnetic & radiation environmental monitoring, environmental protection, uranium ore, nuclear and radiation emergency, nuclear radiation protection and environmental impact assessment, etc. [4].

This study suggests that **NRSSS** should consist of 10 parts in accordance with the corresponding professional field, they are the 10 domain standard families: the general standards (0-GS), nuclear power plant standards (1-NPPS), nuclear research reactor standards (2-NRRS), nuclear fuel cycle facilities standards (3-NFCFS), radioactive waste standards (4-RWS), nuclear material control standards (5-NMCS), civil nuclear safety equipment standards (6-NSES), radioactive materials

transportation standards(7-RMTS), radioisotope and irradiation device standards (8-RIDS), and electromagnetic& radiation environment standards (9-ERES). All the families are divided into 10 parts with the number 0 to 9. The overall framework of **NRSSS** is shown in figure 1.

In the general framework, each domain standard family should be further subdivided into different sub-families. This study gives a division method. The method is based on nuclear facilities and nuclear activities involved in the object, process and management requirements, will be included in the field of many standards classified into different categories and levels [5]. Table 1 is a subdivided structure of NPPS family and other nuclear facilities standards families.

Table 3 is a subdivision of electromagnetic& radiation environment standards family (ERES). The standards of ERES include radioactive effluent and emission, monitoring of radiation environment, protection of electromagnetic environment, development and utilization of uranium &thorium ore and exploitation and utilization of associated minerals.

The basic structure of a complete ERES should cover the radiation environmental quality, on-site monitoring and experimental analysis and measurement methods, including the general electromagnetic and ionizing radiation in two categories.

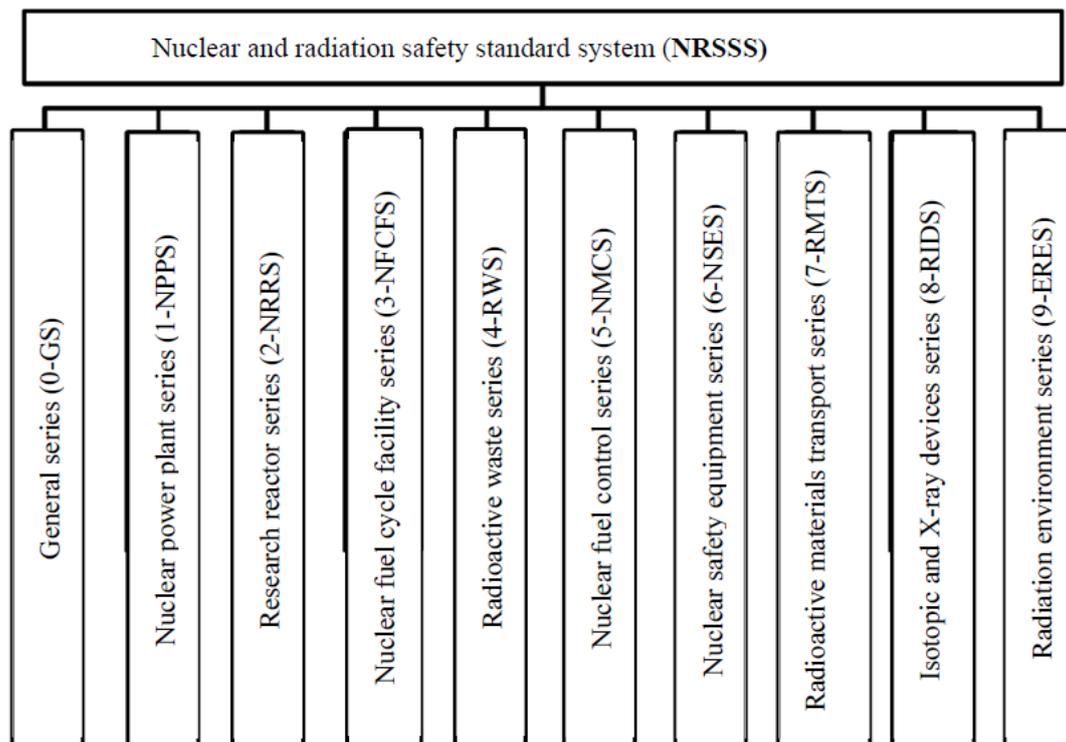


Figure 1. The overall framework of NRSSS

Table 1. Sub-structure of nuclear facilities safety standard families

No.	families	Sub-families
1	NPPS	Site safety standards of nuclear power plants
		Design safety standards of nuclear power plants
		Construction safety standards of nuclear power plants
		Operation, maintenance, safety and aging management standards of nuclear power plants
		Decommissioning safety standards of nuclear power plants
2	NRRS	Site safety standards of nuclear research reactors
		Design safety standards of nuclear research reactors
		Construction safety standards of nuclear research reactors
		Operation, maintenance, safety and aging management standards of nuclear research reactors
		Decommissioning safety standards of nuclear research reactors
3	NFCFS	Site safety standards of nuclear fuel cycle facilities
		Design and construction safety standards of nuclear fuel cycle facilities
		Operation and maintenance safety standards of nuclear fuel cycle facilities
		Criticality safety of nuclear fuel cycle facilities
		Decommissioning safety standards of nuclear fuel cycle facilities

Similarly, others domain standard families are further subdivided according to their field, scope, affiliation, safety requirements. For example, the radioisotope and irradiation device standards (RIDS) family can be subdivided into radiation sources and radiation devices safety standards subfamily. The radioactive materials transportation standards (RMTS) family can be subdivided into subfamilies including the safety requirements of packages, the safety requirements for transport containers, the safety management of transportation, the monitoring of transportation radiation and the emergency handling standards for accidents. Other standards relating to nuclear quality assurance and emergency management of nuclear and radiological accidents can be classified in GS family.

Table 2. Sub-structure of RWS family

No.	Sub-family
1	Standards for generation, treatment, and discharge of radioactive waste
2	Standards for storage of radioactive waste
3	Standards for disposal of radioactive waste
4	Standards for decommissioning and environmental restoration of radioactive waste
5	Standards for waste management of uranium mining and metallurgy

Table 3. Sub-structure of ERES family

No.	Sub-family	Further subdivision standards
1	Radioactive effluent and discharge standards	Effluent discharge requirements and limits
		Effluent monitoring method
		Environmental quality requirements and monitoring standards for ionizing radiation
2	Radiation environment monitoring	Environmental protection regulations and monitoring methods for electromagnetic radiation
		Supervised monitoring for radiation environment of Nuclear facilities
		Development and utilization of uranium & thorium ore and associated ore, radiation safety and environmental monitoring

5. Implementation recommendations

The paper suggests that China's nuclear safety regulatory authority should carry out overall planning and top design as early as possible, to determine the structural framework, hierarchy, and categories of NRSSS, and carry out a series of standardized key projects, and gradually build and improve relevant domain standards system, and eventually formed a complete NRSSS.

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