Comparison of global high-level waste treatment status and domestic situation

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1. Introduction

As an alternative to carbon neutrality, countries around the world are changing their perception of nuclear power generation. France announced the construction of up to 14 new nuclear power plants by 2050, and Japan announced an extension of the operating period of existing nuclear power plants. Korea also plans to abolish the nuclear power plant policy and increase the share of nuclear power to more than 30% by 2030. However, along with the expanding nuclear power industry, the amount of spent nuclear fuel, that is, high-level radioactive waste, is also rapidly increasing. In this paper, the current status of construction and operation of interim storage and permanent disposal facilities for high-level waste treatment around the world is reviewed, and through this, the urgency of high-level waste treatment in Korea is reported.

2. Main Subject

2.1 Definition of Radioactive Waste

According to Article 2 of the Nuclear Safety Act, “Radioactive waste” refers to radioactive material or material contaminated by it and subject to disposal (including spent nuclear fuel that has been decided to be disposed of). Radioactive waste is further divided into intermediate/low-level waste and high-level waste (spent nuclear fuel) according to the intensity of radioactivity. Among them, high-level radioactive waste refers to nuclides that emit alpha rays with a heat generation of 2kW/m3 and a half-life of 20 years or more, and a radioactive concentration of 4000 Bq/g or more. In Korea, most of the high-level radioactive waste is spent nuclear fuel.(Fig.1.)

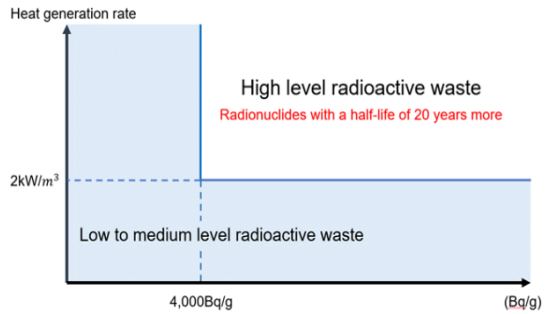

Fig.1. Standard for classification of radiation waste under nuclear power related laws

2.2 Spent fuel disposal method

The process of disposing of spent nuclear fuel can be divided into three stages. The first step is the wet storage step. It is placed in a storage tank inside a nuclear power plant to reduce the high heat and radioactivity emitted from spent nuclear fuel. The second step is the dry storage step. If the wet storage period is about 5 years or more, cooling through air is possible. The first two stages are called interim storage stages, and the last three stages are permanent disposal stages. The International Atomic Energy Agency (IAEA) recommends deep disposal in comprehensive consideration of economic feasibility and safety. Deep disposal is a method of disposing of spent nuclear fuel in a stable geological layer at a depth of 500 to 1,000m underground in a container that can withstand corrosion and pressure for a long time.

2.3 Status of interim storage and permanent disposal facilities in major countries

The United States has installed and operated interim storage facilities in power plants. The operating period is 40 years, and an additional extension of up to 40 years is possible, so there is ample space for intermediate storage. In addition, in May of this year, construction and operation licenses for intermediate storage facilities were completed by the NRC, which can store 5,000 MTU worth of spent nuclear fuel for 40 years. In the case of Sweden, after site selection was completed in 2009, a permanent disposal facility is under construction after obtaining a construction permit for 22 years. Germany, Spain, the Czech Republic, and Japan are in the process of selecting sites for permanent disposal facilities, and France and Switzerland have completed site selection and approval for construction of permanent disposal facilities. Most notable is Finland. Finland started discussing the construction of a radioactive waste facility in 1983, confirmed the site in 2001, started construction in 2015, completed construction in 2023 this year, and is about to operate the world's first permanent disposal facility. The facility can store about 100 years of spent nuclear fuel in a bedrock 450 m underground.

2.4 Domestic Spent Nuclear Fuel Generation Status and Storage Status

Since the start of nuclear power generation in 1978, about 18,600 tons of spent nuclear fuel has been stored in the spent fuel storage tank inside the nuclear power

plant for 45 years. Even this is expected to be saturated, starting with Kori and Hanbit headquarters in 2030, the Hanul headquarters in 2031, and the temporary storage tanks in Shinwolseong headquarters in 2042. Although MACSTOR expansion construction is underway after the approval of the new MACSTOR construction in January 2020, even this is expected to be saturated by 2037. If the temporary storage facility is not expanded, the operating nuclear power plant will have to be stopped. In order to prevent this situation, it is an urgent time to enact the 'Special Act on High Level Radioactive Waste'.

3. Conclusions

Nuclear power generation is classified as eco-friendly energy and has emerged as one of the important future energy sources. However, an essential accompanying problem to sustain nuclear power generation is the disposal of high-level radioactive waste. In the case of France, it took 58 years from the selection of the site for the permanent disposal facility to the final decision. For a long time, in order to gain public trust, public opinions were collected in various ways, such as transparent information disclosure and public discussions.

Korea has a similar experience. In 2017, the construction of Shin-Kori Units 5 and 6 was resumed after a public discussion process. The construction of the new MACSTOR was also able to proceed with active support from the people. As a result, it is necessary to review the approaches of other countries that have secured permanent disposal facilities in other to sustain the nuclear power industry and apply them to Korea. The first step is to publicize the treatment of high-level nuclear waste. Through this, it will be possible to secure high-level waste treatment facilities without missing the golden time of nuclear power plants in Korea.

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