A Review on the Status of the Decommissioning Waste Recycling System in the World

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1. Introduction

A large amount of radioactive wastes are generated during the decommissioning of the nuclear power plant. A large part of the generated decommissioning wastes has a very low-contaminated level of radioactivity. In order to manage these effectively, the recycling of these wastes are necessary, so that it is important to develop domestic recycling scenarios for the effective waste management. Accordingly, for the development of domestic recycling scenarios, the overseas waste recycling system and status were surveyed, and its implications were considered. This will provide the necessary data for the development of a domestic decommissioning waste recycling scenario.

2. Overseas status of the waste clearence system

The term of “waste clearence “is refered to "waste self-disposal" in Korea, which can be managed by incineration, landfill, recycling, etc. as the same manner of the conventional wastes, excluded from the regulatory concern due to the minimal radioactive effects[1].

When operating or dismantling a nuclear power plant, it is inevitably required to treat radioactive waste, and its clearence levels vary from country to country. Korea has similarly defined the radioactive waste classification system with the same of IAEA, in the NSSC Notice 2020-6 "Regulations on the Classification of Radioactive Wastes and the Self-Disposal Standards". The current status and cases of self-disposal regulations are introduced in various countries in the world.

2.1 The United Kingdom

The UK is implementing the EU Directive (96/26/Euratom) through the "Ionizing Radiation Regulation 1999", Major matters clearance, exemption and disposal of radioactive waste are set forth in the Radioactive Substances Act 1993 (RSA 93).

The "Radioactive Substances Act 1993" was not revised as the assessment of the current deregulation-related provisions concluded that it was almost in line with the individual dose standard 10μSv/y.

Surface contamination standards are evaluated on a case-by-case basis, and volume contamination standards are 0.4 Bq/g for artificial nuclides and 0.37 to 11.1 Bq/g for natural radionuclides depending on the element.[2].

Currently, we are deregulating based on 10 μSv/y,

A small amount of very low level waste must have a total radioactivity of less than 400 kBq per 0.1 ㎥ or a total activity of less than 40 kBq (H-3 and C-14 are 10 times this limit), and a large amount of ultra-low-level waste must have a total radioactivity concentration of less than 4 MBq/ton(4 Bq/g) (H-3 is 10 times this limit).[3]

2.2 Belgium

Belgium applies radiation protection standards based on Basic Safety Standards, as specified in the EU Directive 80/836/Euratom (revised thereafter to 84/467/Euratom). Radioactive wastes exceeding the level of natural radiation are regulated in accordance with separate provisions of the Act, and there is no general deregulation level applied to solid wastes.

Meanwhile, recently, surface and volume contamination standards are partially allowed to be deregulated by each case, and it is known that the values recommended by IAEA-TECDOC-855 are referred to as deregulation standards. The individual dose reference value (10 μSv/y) of IAEA-TECDOC-855 is applied and the optimization or collective dose reference value (1 person-Sv/y) is applied.

2.3 Germany

The safety regulations of the Nuclear Act and related ordinances are additionally included by general administrative regulations, guidelines, the Nuclear Safety Standards Committee (KTA), the Nuclear Safety Committee (RSK), the Radiation Protection Committee (SSK), and the radioactive waste management. In Germany, very low-level waste is not considered radioactive waste. Germany has limited and unlimited releases.

According to the recommendation of the Radiation Protection Agency (SSK), the surface and volume contamination standards have nuclide-specific standards based on the individual dose standards (10 μSv/y) and are permitted to deregulate (e.g. landfill or incineration of 4 Bq/g of Co-60). 10 μSv/y is applied as a deregulation basis for the site.

2.4 the United States

After withdrawing the BRC policy statement, the U.S. NRC resumed research to derive deregulation standards from 1994 and published NUREG-1640 in 1999 to present deregulation concentration standards. However, there have been various differences between the public and the industry, and the review is currently being re-examined under the leadership of the National Academy of Sciences. In addition, the American Society of Health Physics published the Industrial Technology Standards ANSI/HPS-N13.12 (1999) on

pre-screening standards for deregulation, but it has not yet been applied in practice because regulators have not adopted the standards.

2.5 Japan

Japan has three main categories: high-level, low-level, very low-level and clearance waste. A system was introduced to verify the risk of wastes containing very small amounts of radioactive materials at very low-levels through certain procedures and licensed methods, and then to treat them equally with general wastes through deregulation. The system is called the "clearance system" in Japan.[4].

The surface contamination standard is converted from the surface contamination density to the concentration level of radioactive nuclide, which is 10 μSv per year due to the human body contamination standard is based on the concentration level of radioactive nuclide. Currently, objects subject to self-disposal are limited to metals and concrete, and expanded applications such as thermos, plastics, and rubber are under consideration.

2.6 France

In France, radioactive waste is classified as a zone according to the degree of contamination, and waste generated from the zone is classified as radioactive waste and industrial waste. All French nuclear installations must establish radioactive waste zones to separate areas where the waste is actually contaminated or likely to be radioactive (radioactive waste zones) from all other zones (industrial waste zones) that are not at risk of contamination or radiation.[5].
France does not operate a waste clearence system, and waste generated from radioactive waste areas is classified as very low-level waste

2.7 Country by Summary

country	Surface contamination limit	Volumetric contamination limit	note
United States	Not currently approved or developed	Not currently approved or developed	Clearence not in operation
Japan	Converting concentrations from surface contamination density	concentration equivalent to individual dose 0.1 mSv	Clearence only to metal and concrete waste
Belgium	Case-by-case evaluation	Case-by-case evaluation	Collective dose 1 man·Sv/y
France	Case-by-case evaluation	Case-by-case evaluation	Clearence not in operation
Germany	0.1 mSv of personal dose concentration	concentration equivalent to individual dose 0.1 mSv	
United Kingdom	Case-by-case evaluation	Artificial nuclides are 0.4 Bq/g. Other than 0.37~11.1 Bq/g	clearence based on 0.01 mSv/y

3. Conclusions

In this study, the self-disposal system and current status of foreign countries were analyzed. Internationally, more and more countries are implementing self-disposal for efficient management of decommissioning waste. This is because large amounts of clearance waste are generated through the dismantling of nuclear facilities. In order to revitalize clearance in Korea, it is necessary to supplement current clearance related systems and regulations. First, considering the characteristics of the dismantling waste in the current notice of in-house disposal, it is recommended that the concentration of in-house disposal based on surface contamination should also be presented as in overseas countries. Second, the related notifications and guidelines stipulate the radioactivity concentration of each nuclear species by recycling scenario of metal and concrete waste that is expected to be mass generated and recycled. Third, it is necessary to establish standards for residual radioactivity measurement methods considering the characteristics of wastes to enhance the convenience of operators.

The clearance system may vary from country to country considering the adoption of disposal facilities, usable land area and public acceptance. But the international cooperative activities are expanded and strengthened around the IAEA and the European Union.[6] in these days. In Korea, it is necessary to actively respond to the recycling plan of self-disposable waste or very low-level waste in connection with the overseas self-disposal system and current status.

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