Development of the Concept of Treatment Process by Type of Solid Radioactive Waste in Radioactive Waste Treatment Facilities

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1. Introduction

Kori unit 1 and Wolsong unit 1 were permanent shut down in 2017, 2019, respectively. In Korea, according to the Nuclear Safety Act, the Final Decommissioning Plan (FDP) must be submitted within 5 years of permanent shutdown. According to NSSC Notice, methods of treatment process should be included in FDP chapter 9, Radioactive Waste Management. In addition, during decommissioning, a large amount of radioactive waste is generated. Radioactive waste treatment facilities (RWTF) will be built in each site to treat large amounts of radioactive waste. Therefore, in this study, concept of treatment process by type of solid radioactive waste in RWTF was developed.

Fig 1. Planned site of radioactive waste treatment facility in Kori-1 & Wolsong-1

2. Materials & Methods

2.1. Types of decommissioning solid radioactive waste

Solid radioactive waste depending on the characteristics of the generation was classified into reactor vessel internal (RVI), reactor vessel (RV), large components (Steam Generator, Pressurizer, etc), small metals, spent nuclear fuel storage racks, insulation, wires, concrete debris including bioshield, scabbling concrete, soil, spent resins and filters, and dry active waste (DAW).

2.2. Solid radioactive waste treatment equipment

Radioactive waste treatment equipment is divided into cutting, decontamination, reduction, solidification equipment.

Cutting equipment is used to cut large components and small metals, and is divided into mechanical cutting and thermal cutting equipment.

Decontamination equipment is used to reduce the level of contamination of radioactive waste and is divided into dry abrasive blasting, high-pressure water jet, and ultrasonic decontamination equipment.

Reduction equipment is used to reduce the volume of radioactive waste and is divided into induction melter (IM), plasma torch melter (PTM), and high-pressure compressor equipment.

Solidification equipment is used to stabilization radioactive waste and includes cement solidification equipment.

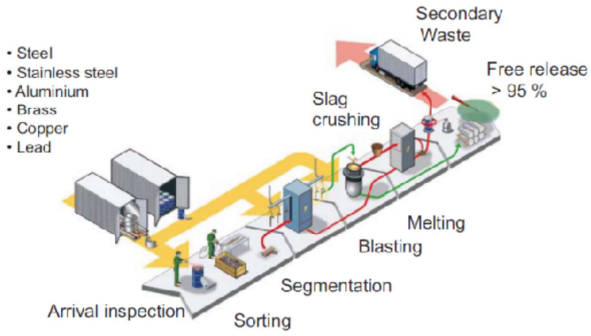

Fig 2. Induction Melter operation process in Studsvik

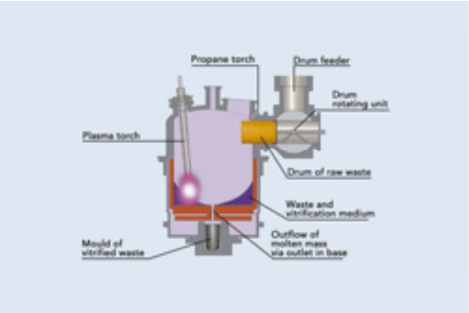

Fig 3. Plasma Torch Melter in Zwilag

2.3. Solid radioactive waste classification applied to treatment processes

The treatment process was divided into 3 types: single process, multiple process, packaging that solidifies if necessary.

3. Results

Table 1 shows classification of single process, multiple process, and packaging by radioactive waste type. The radioactive waste types that are treated by a single process include large component (SG Inconel), insulation, wire, and DAW. The radioactive waste types that are treated by multiple processes include large components (excluding SG Inconel), spent nuclear fuel storage racks, and small metals. The radioactive waste types that are simply packaged or packaged after immobilized without volume reduction include RVI, RV, spent resins and filters, concrete debris, and scabbling concrete.

Table 1. Classification of treatment processes by radioactive waste type

Process	Types	
Single process	Large component (SG inconel)	
	Insulation	
	Wire	
	DAW	Combustibility
		Compressibility
		Metal
		miscellaneous
Multiple process	Large component	
	Spent nuclear fuel storage racks	
	Small metals	
Packaging* (without volume reduction)	RVI	
	RV	
	Spent resins and filters	
	Concrete debris	
	Scabbling concrete	

*Packaging after solidification as required

Among single process radioactive waste, SG Inconel, insulation, wire, and DAW (combustibility, compressibility) are treated using high-pressure compressor equipment, and the reduction ratio varies depending on each waste type. Metals and miscellaneous DAW are treated using induction melter and plasma torch melter, respectively.

All multiple process radioactive waste is treated using induction melter after a segmentation process at a RWTF. When treated by multiple processes, it is necessary to consider the before and after processes when selecting the reduction ratio. Therefore, after selecting the expected total reduction ratio in consideration of the characteristics of the waste, the reduction ratio was selected in consideration of the expected degree according to the waste type and treatment equipment.

Radioactive wastes that are difficult to treat, such as RVI, RV, spent resins and filters are simply packaged or solidification and then packaged.

4. Conclusions

In this study, concept of treatment process by type of solid radioactive waste in RWTF was developed. Radioactive waste treatment equipment is divided into cutting, decontamination, reduction, immobilization equipment. The treatment process was divided into 3 types: single process, multiple process, packaging that immobilizes if necessary. The results of this study can be used as a basis for FDP development and design of RWTF.

REFERENCES

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