Consideration of Treatment and Disposal for Decommissioning Waste

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1. Introduction

On June 19, 2017, Korea's first commercial nuclear power plant, Kori Unit1, was permanently shut-down for decommissioning. After about 5 years of transition period, the spent fuel is defueled to the off-site and then actual dismantling could begin.

The Kori Unit1 decommissioning waste that is expected to be generated in the dismantling of one nuclear power plant is approximately 80,000 drums. However, we are aimed at reducing to 14,500 drums by applying a volume reduction technique (1drum = 200ℓ) [1].

In this study, we are going to define the sources of decommissioning waste and analyze the proper processing and disposal plan in Korea.

2. Decommissioning Waste

2.1 Decommissioning Waste Generation

Decommissioning wastes generated during the dismantling process are characterized by the generation of a large amount of waste in short period and various source terms.

Some are produced primarily through decontamination and dismantling process of contaminated SSCs, and the other are during the decontamination process whose objective is to reduce the radioactivity level to a goal for recycling or clearance waste. A portion of wastes could be generated in the form of mixed waste with non-radioactive or radioactive and hazardous materials mixed. The waste disposal cost of dismantled waste accounts for approximately 40% of the total decommissioning cost [2].

2.2 Solid Waste

Solid wastes are classified as activated metal waste (RVI, RPV), radioactive concrete waste (Bioshield concrete), and soil waste (Excavated soil exceeding DCGL). In addition, wet wastes (spent resin, filter, sludge) generated from the liquid radioactive waste management system or facility. And also dry waste (air cleanup filter, dry active waste) from HVAC and decontamination process. The others are classified as mixed wastes in which radioactive and non-radioactive materials with harmful material are mixed.

2.3 Liquid Waste

Liquid radioactive wastes are decontamination liquid wastes generated by the decontamination SSCs, system water from fuel pool cooling and filtering system and laundry waste by workers' clothing washing and personal decontamination.

2.4 Gaseous Waste

Gaseous wastes would be produced during decontamination and cutting operations. Types of them consist of radioactive particulates suspended in the air of buildings and exhaust gases generated during the melting process. In order to manage radioactive dusts that could be generated during dismantling work, separate air purification equipment such as temporary pollution control equipment and dust collector is needed.

2.5 Comparison of Generated Decommissioning Waste

Table 1. Comparison generated waste by Classification

Waste Classification	Generated Decommissioning Waste (m^3)			
	EU	Maine Yankee	Rancho Seco	KORI
Class A	2,911	90,650	17,244	5,759
Class B/C	2,459	570	93	5,990
GTCC	109	-	11	21
Sum	5,479	106,610	17,348	11,770

3. Consideration for Decommissioning waste processing and disposal

Dismantled wastes should be considered for the disposal according to the material and form, apart from the level of radioactive contamination.

The purpose of this section is to describe the requirements for the radioactive waste generated from dismantlement by the situation in Korea. The following are important considerations in the disposal of decommissioning waste.

3.1 ILW, LLW Radioactive waste Acceptance criteria

The total radioactivity at the KORAD disposal facility is 1.08E+16Bq. But the radioactivity calculated through the source term evaluation of Kori Unit1 reactor vessel internal is 7.65E+16Bq which, therefore, cannot be disposed at KORAD disposal facility.

If intermediate wastes generated form Kori Unit1 are not met the acceptance criterion of KORAD, additional waste storage on site is required. This problem causes an increase in decommissioning cost and worker's exposure.

3.2 Development for waste disposal container

Up to date, the container for disposal of decommissioning waste is limited to 200ℓ drums in Korea. When decommissioning, wastes of various shapes and sizes are generated. In order to pack into the 200ℓ drum containers, more cutting process should be needed and resulted in a large amount of secondary wastes and increased worker exposure.

Developing disposal waste containers is needed to minimize worker's radiation exposure and to optimize decommissioning costs.

3.3 GTCC disposal methodology

GTCC, such as reactor vessel internal, is currently not disposable in KORAD. In case of Connecticut Yankee Nuclear power station, RVI was disposed by using ISFSI (Independent Spent Fuel Storage Installation) disposal container.

If RVI is able to be disposed of in container that used for Spent Fuel dry storage, it could be disposed of without any additional safety or sensitivity assessment.

3.4 Design of Decommissioning Waste Processing Facility

The wastes generated during the dismantling process should be treated by using the existing waste management system.

If there is a large amount of wastes exceeding the capacity of the existing facilities or having unacceptable characteristics, a comprehensive disposal facility for disposal waste should be designed.

Therefore, the Comprehensive Disposal Facility would ensure processing performance and capacity based on the expected type, characteristics, amount generated, treatment level, technology level and regulatory condition which are on the basis of evaluation of the radiological characteristics and developing the technology of D&D. Furthermore the Comprehensive Disposal Facility should be designed considering these results.

4. Conclusion

Decommissioning strategy of KHNP is to immediately dismantle Kori Unit1. In order for the decommissioing schedule to proceed in an efficient manner, the hurdles of disposal waste treatment must be solved first. Otherwise, the decommissioning schedule would be delayed which results in increasing the decommissioning cost and the radiation exposure of the workers.

Before the actual dismantling work begins, to solve the considerations mentioned above, it will be necessary to concentrate on R&D and standardization criteria for disposal waste during the transition period.

REFERENCES

[1] Jong Soon Song, Young-Guk Kim, Sang-Heon Lee, "A Pre-Study on the Estimation of NPP Decommissioning Radioactive Waste and Disposal costs for Applying New Classification Criteria", Journal of Nuclear Fuel Cycle and Waste Technology, Vol. 13 No.1 (2015).

[2] Notice of MOTIE (Ministry of Trade, Industry and Energy) 2015-132 "Notice of cost estimation standard for radioactive waste management and spent fuel management (2015).