Necessity of Reasonable Consideration About Disposal Condition for VLLW (Very Low Level Radioactive Waste) of NPP Decommissioning

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1. Introduction

Change of government's energy policy have effected on nuclear industry. The first commercial NPP (Nuclear Power Plant) in Korea, Kori-1, will be decommissioned and Wolsung-1 will take a step for permanent shutdown and decommissioning. Under this situation, It is possible to predict that the radioactive waste will increase during the NPPs (Nuclear Power Plant) decommissioning period. Therefore, radioactive waste disposal will be a major problem without proper disposal criteria. Especially, it is necessary to consider more effective method to dispose Very Low Level Radioactive Waste (VLLW) which is the largest amount of radioactive Waste. To do this, the reasonable disposal criteria for VLLW should be established based on experience and technical knowledge. The purpose of this study is to suggest necessity of appropriate disposal criteria and treatment for VLLW of NPP decommissioning

2. Current state about VLLW disposal

2.1 Properties of decommissioning waste

Kori unit 1 will be decommissioned in several years. Then, large amount of waste generation will be expected during the decommissioning. Therefore, proper management for decommissioning waste is able to effect on result of decommissioning. For this objective, properties of decommissioning waste should be analyzed. Table 1 shows the properties of waste of NPPs decommissioning

Table 1. The properties of decommissioning waste [1]

Properties	Description
Kinds of waste	· Almost is industrial waste · Most of radioactive waste is VLLW · Just few of ILW and LLW
Amount	· Large volume of waste · Generated in short time
Applicable Management	· Extension of Self disposal · Recycling for metallic waste

As shown in Table 1, decommissioning waste has many kinds of properties. Moreover, it will be able to affect decommissioning strategy. Therefore, analyzing result of decommissioning effect which is considering decommissioning waste properties are very important to perform decommissioning successfully.

2.2 Generation ratio of VLLW of NPP decommissioning.

The amount of waste is important factor to establish decommissioning strategy because it is possible to affect economics of decommissioning due to the high cost for waste disposal. Therefore evaluation for exact prediction of waste amount is important. However, it is difficult to predict exact amount of radioactive waste during the NPP decommissioning. For example, real waste quantity is more than expected quantity decommissioning in USA due to increase of contaminated soil [2]. Since, there is no standard to predict exact quantity of radioactive waste during NPPs decommissioning. Moreover, amount of radioactive waste can be affected by government policy, decommissioning strategy and regulations [3]. According to the revised classification criteria of IAEA total amount of waste will be 14,000 (200 L Drum) during the NPPs decommissioning of 900 ~ 1,300 MWe PWR type. Table 2 shows the predictive VLLW amount of other countries.

Table 2. Prediction about VLLW amount of countries [4]

Country	Total Waste	VLLW(%)
Korea	14,500 Drum	6184 Drum(42.6%)
France	85,500 Drum	50,000 Drum (58.5%)
Japan	4.213 ton	2,823 ton (67%)

2.3 Consideration of Treatment for Particulate VLLW

The cost of waste management is the largest portion of total decommissioning budget.(225,577 M USD, 39%) Therefore, the effective management plan for waste should be established to implement decommissioning NPPs economically. In particular, it needs appropriate evaluation about VLLW waste. Since, as shown in Table 2, VLLW is the largest volume of waste. It means that if we can decrease the cost of disposal for VLLW, total cost of decommissioning will be decreased. Moreover, as shown Table 3, cost for disposal has increased. Thus, it is possible to foresee the total cost of NPP decommissioning will increase in future.

Table 3. Change of cost for disposal waste

Years	2010	2012	2015
Cost for drum	6,600 USD	10,650 USD	13,700 USD

In addition, additional treatment for VLLR such as immobilization or stabilization and etc, is another factor which can raise the disposal cost. For example, concrete and soil occupy the large amount of decommissioning waste. According the Korean waste acceptance criteria,

these kinds of waste are should be immobilized or solidified by specific matrix like a Polymer, Paraffin or using vitrification. And also, the homogeneous waste like a spent resin, soil, concentrated waste fluid should be solidified and hetero generous waste such a concrete and metal scrap have to be immobilized. These additional treatments can lead volume increase of waste drum for VLLW. As a result of that, total cost of decommissioning can increase. Table 4 shows the comparison of the additional treatment including cost and volume increase.

Table 4. Comparison of treatment cost for VLLW

Treatment	Vinyl Package	Cement Solidification	Polymer Solidification
Volume Increase	-	100%	50%
Cost Increase	120 USD	30,000 USD	23,000 USD

2.4 Particulate VLLW Treatment of foreign case

The acceptance criteria in Korea for particulate VLLW is more ambiguous than other country. So, it is difficult to dispose particulate VLLW efficiently without specific conditions of treatment for VLLW such as stabilization, solidification. Many other countries have their own acceptance criteria for VLLW. The acceptance criteria has established according to properties of VLLW and disposal facility. Table 2 shows various VLLW treatment of foreign country. Thus, they can improve the effectiveness of waste disposal by applying various acceptance criteria such a characteristic of physical and chemical, package for radioactive waste. Therefore, it is necessary to analyze method of VLLW treatment in foreign countries to establish more effective and reasonable acceptance criteria for VLLW.

Table 5. VLLW treatment of foreign country

Country	USA	SPAIN	UK
Waste Class	Class A	VLLW	VLLW
Treatment	No Stabilization	Without solidification pretreatment	No additional Treatment
Package	Soft-bag	Flexible Package	Soft-side

3. Proposal to overcome difficulties

There are multifarious considerations to establish reasonable acceptance criteria for VLLW. Since, there is no exact information of decommissioning waste in Korea. Consequently, lots of opinion could be raised by various expert groups [5]. Therefore, to establish reliable and effective acceptance criteria for VLLW, continuous efforts, as following challenges, are needed.

- Radioactive effects of VLLW should be evaluated by adapting more advanced technique which can predict exact VLLW amount and environmental effect
- It needs sufficient research and review about foreign case when adjust acceptance criteria for VLLW.
- The communication among NPPs operator, disposal facility agent, the public and government has to be taken actively to apply effective and economical waste treatment.

Careful and steady research of foreign case, applying new technology, smooth communication system can be a core requirement to establish reasonable acceptance criteria for VLLW.

4. Conclusion

Government has tried to enforce safety regulation to satisfy people's sympathy against radioactive concern. In addition, government is concerning the disposal of radioactivity waste, because of resent social issue related Radon mattress. As a result of that, the worry about radioactivity waste has been increased much more than before. In this state, it is essential to consider various methodologies to improve economics and safety of decommissioning for Kori-1. Particularly, reasonable acceptance criteria and effective VLLW treatment will be a key factor to perform efficient and safe decommissioning. This paper suggested proposal to incarnate VLLW disposal condition by comparing and analyzing various data. Reliable and effective VLLW waste disposal could be achieved by adopting reasonable disposal criteria and researching enormous information including foreign case. And also, active analysis and steady effort to develop advanced methodology will be able to reduce potential risk of the radioactive waste amount and its environmental effect. These suggestions of this paper can be used as meaningful data to specify effective acceptance criteria and reasonable policy for radioactive waste of NPPs decommissioning.

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