Concentration Averaging Option of NPP Decommissioning Low Level Radioactive Waste

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1. Introduction

Disposal choices according to domestic radioactive waste classification are as illustrated in Fig. 1. The intermediate and low level wastes occurred from immediately decommissioning Kori NPP Unit 1 are estimated mostly to be the low and very low levels with VLLW 9.2% higher than LLW. The net volume generation of intermediate and low level radioactive wastes expected to occur upon immediate decommissioning of Kori NPP Unit 1 is estimated to be 0.2% for the intermediate level, 45.3% for the low level, and 54.5% for the very low level. Scabbling concrete is estimated to have a very low level almost three times more generated than the low level [1]. Scabbling concrete is defined as dust-form concrete of the structure removed by scabbler and is expected to be potential target for concentration averaging. US NRC's position is that if concentration averaging or blending does not diminish the overall safety of LLW disposal, CA or blending can be allowed.

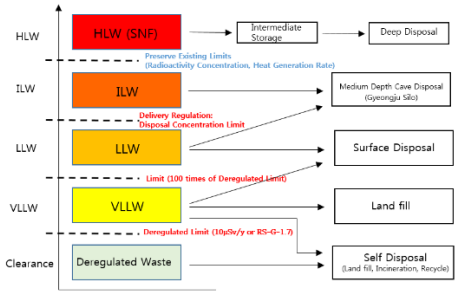

Fig. 1. Radioactive Waste Classification vs Disposal Option.

It is suggested that the activated bio-shield concrete could be concentration averaged to VLLW for disposal after sectioning the activated part [2].

2. Concentration Averaging of Decommissioning Waste

2.1 Blending concept

The NRC defines blending as a relatively uniform mixing of low level wastes with different radioactivity concentrations, so being appropriate for disposal. The types of wastes include those that have physical and chemical similarities, such as ion exchange resin from each system of a nuclear power plant, but may include other types of wastes as long as the final mixture can be homogeneous, such as soil or ash. To demonstrate that waste is adequately blended, there shall be no hot spots of waste ≥0.2 m^3 that have a sum of fractions >10 times the average concentration of the blended product for the specific radionuclides [3].

2.2 Concentration Averaging Application

In the United States, the concept of concentration averaging was newly established in 2015. This includes the mixing of wastes with different concentrations or the determination of the concentration of wastes with different concentrations. When decommissioning nuclear power plants in the future, many wastes are generated, so that the handling and disposal of wastes can be efficiently performed by using the concept of concentration averaging.

Intermediate and low Level radioactive wastes from decommissioning Kori NPP Unit 1 are possibly treated to lower radioactivity concentration or radioactivity by blending, concentration averaging or encapsulation. Scabbling concrete is likely to be appropriate for concentration averaging rather than blending a waste stream. The amount of scabbling concrete classified as low level is estimated to be tens of 200L drums.

In the case of decommissioned wastes, there is a few waste with hotspots, so concentration averaging is possibly applied to mix different waste streams with different concentrations or mass of concrete or metal with different concentrations. It is stipulated that the radioactive material should not be diluted or mixed intentionally according to the Notification Notice of Korean Nuclear Safety and Security Commission, but this is to prevent the release of the radioactive material into the general environment. That is, some of the high-level wastes are classified as low level waste by mixing them with low level wastes, and there is no problem because they are disposed of as radioactive waste.

2.3 Domestic Availability

In Korea, the acceptance criteria for intermediate and low level wastes are expected to be the same except for the concentration of wastes. However, the acceptance criteria for very low level wastes will be eased considerably compared to intermediate and low level wastes. Therefore, there is no blending effect of intermediate level wastes, and only a small part of low level wastes can be blended to be effective.

In the United States, blending is presented in a variety of ways including ion exchange resins, cut cartridge filters, soil, and charcoal. However, in the case of decommissioning wastes from Kori NPP Unit 1, the types of wastes applicable to blending are

limited. For example, the ion exchange resins generated in the decontamination of the primary system are at the intermediate level waste, and the ion exchange resins generated after the treatment of other liquid wastes are at the low level waste.

Very low level ion exchange resins, which may be blended with intermediate and low level ion exchange resins, are not generated. Likewise, waste filters do not have very low level waste. Contaminated soil can be blended to reduce low level waste. It is estimated that contaminated soil wastes are not generated by decontamination at present. In the case of metal, the slag after melting is disposed after being crushed to put it in a large amount in the container, but the radioactivity level is expected to be high, and there will be no blending effect. Thus, the effect of blending can be up to tens of drums in a maximum of almost one hundred drums.

3. Concentration Limit for Blending

3.1 Conditions to potentially facilitate blending

In order to smoothly perform blending, the radioactivity levels of scabbling concrete and contaminated soil, which are likely to be blended from the time of radioactive waste generation, must be determined and managed separately to facilitate blending. Lower level part of scabbling concrete classified as low level waste can be blended with very low level scabbling concrete.

3.2 Concentration Allowance for Mixture

It is recommendable that the radionuclide concentration limit of low level waste to be blended be set at 1.5 times the VLLW class limit of mixture as illustrated in Fig. 2. The factor of 1.5 is reasonable conservatively considering CA BTP 1995 and 2015 versions. However, if the LLW quantity is too high, the factor should be adjusted to 1.3 times, considering the amount of very low level waste in that blending is determined by the concentrations and amounts of very low level and low level wastes. It is estimated that the about 60 drums of scabbling concrete is capable of being blended since 189 drums of LLW and 551 drums of VLLW are generated based on scabbling concrete amounts.

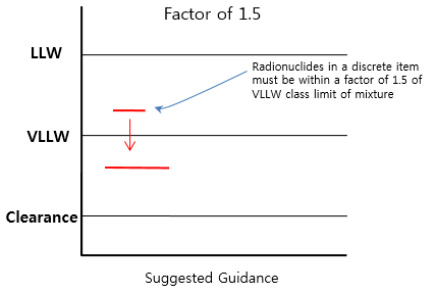

Fig. 2. Radionuclide Concentration Constraint for LLW.

4. Conclusion

Concentration averaging or blending has appropriately been performed if the waste mixture has homogeneous radioactivity concentrations and is radiologically safe without hot spots. Concentration averaging on scabbling concrete requires control of the size and shape of concrete particles as well as the radionuclide concentration or radiation level to ensure homogeneity of the mixture. Radionuclide concentration constraint provides the guidance for each item in LLW mixture to be concentration averaged to VLLW.

Acknowledgements

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