Necessity of Adjustment of Reasonable Acceptance Criteria for Radioactive Waste Disposal

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1. Introduction

The nuclear energy industry has faced new turning point, due to government's new energy change policy. Korea's first commercial NPP (Nuclear Power Plant), Kori-1, will be decommissioned and also Wolsung-1 will shut down permanently in near future. Under this situation, the proper disposal of radioactive waste will be a major issue. Because, the large amount of radioactive waste will be generated during the NPPs (Nuclear Power Plant) decommissioning. Therefore, it is necessary to consider more effective method to dispose lots of radioactive waste. To do this, the acceptance criteria in association with disposal of radioactive waste could be evaluated in a reasonable manner based on experience for the past 8 years. The purpose of this study is to perform various analyses and to review the necessity of appropriate and reasonable adjustment of allowable disposal criteria.

2. Kinds of Difficulties for Disposal

2.1 Limitation of Disposal Concentration Limit

The evaluation of Underground Silo type disposal facility was performed to dispose low and intermediate-level waste by applying IAEA Methodology [1]. As a result, there were 5 radionuclides which have higher radioactivity than that of performance goal for disposal. For the safe disposal of intermediate-level wastes, the DCL (Disposal Concentration Limit) was applied. Table 1 shows the LLCL (Low Level Concentration Limit) and DCL of selected 5 Radionuclides.

Table Ⅰ: LLCL and DCL of 5 Radionuclides

Radionuclide	LLCL(Bq/g)	DCL(Bq/g)
H-3	1.11E+06	3.53E+10
C-14	2.22E+05	3.26E+05
Sr-90	7.40E+04	2.36E+07
Tc-99	1.11E+03	3.07E+06
Gross α	3.70E+03	7.46E+03

Some radionuclides such as C-14 and Gross alpha have too narrow range between LLCL and DCL, which can be shown in Fig.1. Because these 5 radionuclides were evaluated by using well scenario[2] which did not consider active counter measure of main agent such a development of C-14 segregation technology. DCL criteria, for waste disposal that were established with very conservative data, can possibly be immoderately stricter than accident condition in reality such as human invasion, earthquake in facility.

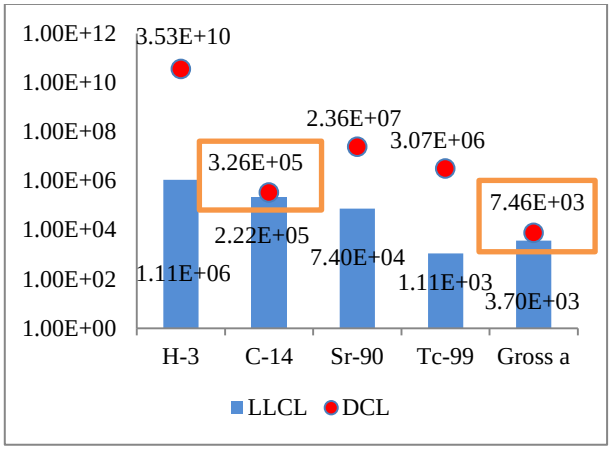

Fig.1. Range of LLCL and DCL of 5 Radionuclides

For example, the SOARCA (The State of the Art Reactor Consequence Analyses): Project of U.S.NRC can evaluate severe accident scenario and its effect by applying the most active responding. As a result, the SOARCA analyses demonstrate the feasibility and potential benefit of mitigation for the analyzed scenario[3]. Therefore, the adjustment can be considered by adopting advanced technology and performing more realistic evaluation which can represent active countermeasures, even the radionuclide has a little bit higher radioactivity than permissible dose in present.

2.2 Review of foreign case

The foreign cases need to be reviewed after sufficient evaluating on present situation. Applying foreign case without enough research will interrupt pragmatic disposal. For example, as shown in table 2, French packing ratio is more severe(97%) than that of Korean case because they just load drum without any treatment. This disposal type is weaker against accident in facility such as sink; and collapse. However, the Korean packing ratio of underground silo type disposal facility is 87%. Because the waste drum will be treated as cement grouting process after loading into disposal

container to avoid any effect to the condition of disposal facility. If Korea adopts France case, many radioactivity waste drum should be repacked resulting in lots of economic lose and time.

Table Ⅱ: Packing Ratio Comparison of Korea and France

Country	Korea	France
Packing Ratio	85%.	97%
Packing type	- Disposal Container - Cement Grouting	Simple load

2.3 Allowable dose rate of facility for disposal

Underground Silo type disposal facility got the license for construction and operation with a dose rate of 0.95mSv/y in 2005. And after performing evaluation with previous allowable criteria for environmental assessment, the limit was change to 0.64mSv/y when underground Silo type disposal facility got license for using in 2014. As a result of that the disposal plan for 5% of all radioactive waste drum should be revised or another disposal facility is needed. NSSC (Nuclear Safety and Security Commission) notice[4] has been revised and new classification for disposal has been adopted. Therefore, the KORAD tries to change their criteria from 0.64mSv/y to 0.93mSv/y after conducting environmental assessment. This leaves rooms for considerations whether to adhere previous standard, because safety issues are sufficiently secured by performing safety evaluation. The history of limit changes is shown in table 3.

Table Ⅲ: The history of limit changes

Year	2005	2014	2017
Dose(mSv/y)	0.95	0.64	0.93*
Applied Basis	DCL in 2005 (LLCL in 2017)	Environmental effect evaluation	Revised NSSC Standard

* To be accepted by NSSC

3. Proposal to overcome difficulties

There are various considerations to adjust acceptance criteria. Because, there are various kinds of wastes from NPP and the method for disposal therefore, lots of opinion could be raised by various expert groups[5]. Reliability and effectiveness of radioactive waste disposal can be achieved when various efforts are made to reach appropriate acceptance criteria with improved technology, through continuous research. Therefore, to establish proper and reasonable acceptance criteria for disposal some challenges can be raised as follows:

- Evaluation measures and scenarios for disposal, using more specific and advanced technique to reduce radioactivity, are needed to improve current safety criteria
- It needs sufficient research and review about foreign case when adopt it.
- Sufficient communication and public hearing should be taken actively among the NPPs operator, disposal facility agent, the public and government.

Based on a careful analysis of foreign case and evaluation scenarios, the established to communication system can improve the reliability of waste disposal system and contribute to apply reasonable standard.

4. Conclusion

The nuclear energy policy of government has entered a new area to enhance safety regulation. In addition, government is concerning the disposal of radioactivity waste, because of NPP decommissioning for Kori-1. The issue related radioactivity waste has been increased much more than previous expectation during NPPs decommissioning in foreign case. Therefore, reasonable disposal criteria has become more essential for the effective waste disposal. This paper suggested proposal to improve the current process for disposal. Reliable and effective radioactive waste disposal could be achieved by adopting reasonable disposal criteria and evaluation model. Active response scenarios and analysis will be able to reduce potential risk of the radioactive accidents in disposal facility significantly. Therefore, it is necessary to establish reasonable acceptance disposal criteria by adjusting through steady effort to develop advanced technique; realistic evaluation scenario and to establish communication system. The recommendations of this paper can be used as useful data to establish advanced acceptance criteria and reasonable policy for radioactivity waste disposal.

5. Acknowledgements

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