# A Safety Concept of Landfill Disposal for National LILW Repository Complex

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## 1. Introduction

Korea Radioactive Waste Agency (KORAD), which has been developing underground silos (2006~) and near-surface vaults (2012~) in the Wolseong site, is now setting its third phase of development for landfill disposal (LD) of very low-level waste (VLLW) in the same site. In order to develop the LD system properly, it is essential to consider its safety features with the disposal site as well as the generic characteristics. This paper discusses the proper concept of landfill disposal for the repository complex and the corresponding implementation.

## 2. The concept of landfill disposal

The NSSC Notice on the classification of radioactive waste defines LD as "disposing of radioactive waste with natural barrier near the surface of the earth" and allows it to accommodate VLLW. This concept of LD could be extended as "disposing of waste near the surface of the earth in such a way that the safety does not rely on engineered barrier." The LD thus has its meaning in a set of the relevant structure of natural barrier and a range of waste disposed of. Correspondingly, an LD system may hold as a disposal "method", not as an engineered "facility."

With some favorable properties of the repository and its structure and arrangement, the natural elements could construct the required safety functions for a limited range of VLLW plus containers without any help of engineering elements. This corresponds to a pure LD system. More generally, an LD system may adopt engineering elements partly to enhance the safety. In this case, the system still could be put into a category of LD as far as the natural elements construct the required safety functions. If such safety features are reliable, it is not necessary to impose some performance criteria to the applied engineering elements. In this relation, supplementary material such as polymer membrane and clay may also be constituent of LD system. On the other hand, if there is an engineering element participating in compliance with the safety objectives, the element should meet the relevant performance requirement like that to near-surface disposal facility. In this case, the repository should actually be considered as a near-surface facility for disposal of VLLW.

## 3. Technical criteria for landfill disposal

In relation with the control of precipitation during operation, LD may be divided into two types: (1) The whole base of repository are formed first to fill waste packages openly, which is suitable for dry sites. (2) The repository is developed gradually with shelters, where trenching, emplacing waste packages, backfilling and covering may proceed little by little. The Wolseong site seems to apply the latter system since it has much rain.

Among the existing technical criteria for near-surface disposal, the following are needed to review in terms of the landfill: siting, structure and equipment, considerations for natural phenomena, and drainage. Since the current standards are basically covering the concept of LD, they may apply properly to LD in terms of the potential hazard. With shaping the development, however, some details may be necessary for some items to discern between engineered facility and landfill.

## 4. Constructing the safety of landfill disposal

The realization of an LD system depends largely on the characteristics of waste and radionuclides involved as well as site characteristics and landfill method. In this context, the safety considerations for development of the LD system on Wolseong site should place the focus on the following issues.

### *4.1 Does the proposed disposal system belong to landfill?*

The case should be examined with due consideration on characteristics of the VLLW including the radionuclide composition. Taking the concept of landfill into consideration, it is desirable to restrict long-lived radionuclides regardless of the waste forms for defense in depth in addition to compliance with the safety objectives.

### *4.2 Is the system making the best use of safety features of LD?*

The safety features of LD may again become

different for different designs and different ways of development. So, it should be confirmed continuously from the beginning to the final phase that the system is to reflect the essential safety features. In particular, for the case of gradual development, the overall validity should be judged in the initial review for permission of the construction and operation and be checked throughout the following phases.

*4.3 Are the functions of drainage and percolated water collection assured?*

As shown in Fig. 1, an LD system may use collectors to collect percolated water after covering till the final closure. In addition, it practically has ditches around the mound for surface drainage, which still may be maintained after the repository closure. Since most radionuclides in the VLLW should be short-lived, the performance of landfill disposal may depend greatly on such water control functions. Therefore, the relevant design shall be demonstrated in advance to assure the expected performance, the installation and covering or (partial) closure be carried out so as to realize the performance, and the function be continuously monitored and (if necessary) corrected throughout the required period. For this purpose, the relevant design and operational specifications shall contain the follow-up measures.

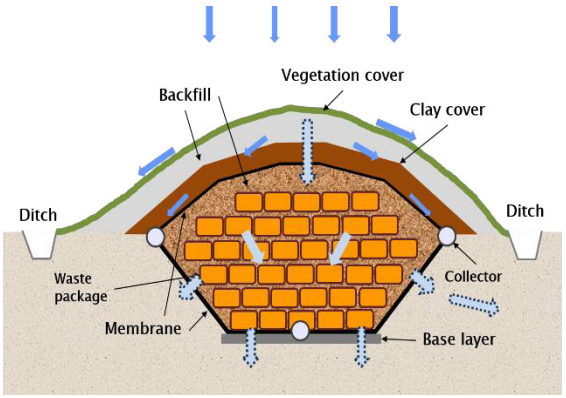

Fig. 1. A typical shape of landfill disposal.

*4.4 Is there no problem with opening the site after post-closure control?*

From its basic idea, MD is rather appropriate to be considered as a practice of "work" than as a "facility." In this context, it is not reasonable to apply the post-closure safety objectives and the related scenario approaches for compliance assessment to the LD in the same way as to the other types of disposal facilities. For example, after the post-closure control, a landfill repository will be faced with a situation of human intrusion as it is on the surface, while other types of repository still have their engineered facilities underground for which the intrusion may be limited considerably. In this sense, the site release approach, as to decommissioning, is more pertinent to a landfill repository. So, the future Wolseong repository complex containing LD should be developed in such a way that it satisfies not only the post-closure safety objectives but also the site release criteria (e.g., 0.1 mSv/y). This indicates again that a limited range of VLLW should be introduced into the landfill. In other words, an insignificant amount of important radionuclides should remain on the site surface after the post-closure control phase.

*4.5 Does the safety assessment support the safety arguments, mentioned above for LD?*

The safety assessment for LD should be based on the concrete description on how the waste will evolve and how the radionuclides will behave. In short, it is essential to predict the distribution of radionuclides around the landfill with time. Accordingly, it should be emphasized that unrealistic simplifications, such as all the radionuclides released from the landfill will come into the groundwater, cannot lead to a valid argument on the safety of the landfill and thus the repository complex.

## 5. Concluding remarks

In view of radiation protection, disposal is just an option for managing radioactive waste safely. If we are to adopt LD as the ultimate phase, we have to understand its safety features and develop the disposal system making their best use. The safety concept discussed here may be a basis for developing the domestic landfill repository.

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