Preliminary Analysis on the Domestic Applicability of Deep Borehole Disposal

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1. Introduction

There are lots of methods to isolate the radioactive waste from human beings. For the spent fuels or high level radioactive waste, a deep geological disposal (DGD) concept is considered as the safest method with the best available technology at present time to isolate them from the biosphere. But as an alternative to the deep geological disposal technology which is considered as a reference concept and currently under the stage of licensing, a deep borehole disposal(DBD) concept to dispose of high level radioactive waste or spent fuels at the depth of 3 to 5 km in crystalline rock that is more stable in geological and geo-hydrological conditions(Fig. 1.) has been studied in the USA and some European countries.

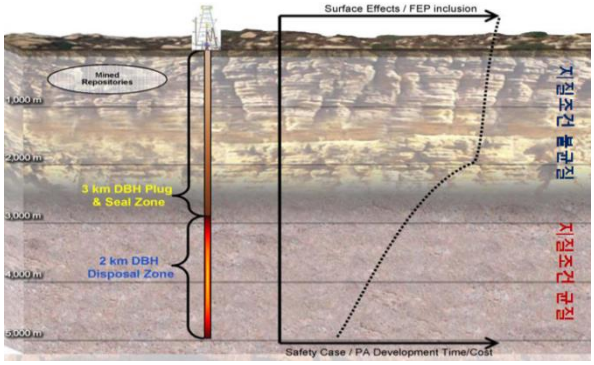


Fig. 1. Geological Condition for DBD[1].

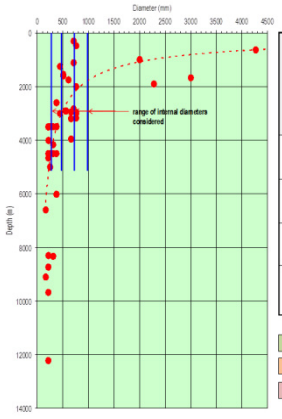
In order to apply the deep borehole disposal concept, it is necessary to secure the drilling and investigation technology for deep borehole with large diameter. With this technology, the geological and geochemical conditions at the depth of 5 km underground should be confirmed to be suitable for deep borehole disposal[2]. Also, the technology for a deep borehole disposal concept and safety assessment should be developed and the technologies are actually demonstrated and proved.

In this paper, the analyses on the applicability of deep borehole disposal in Korea were carried out in technical point of view. The results of this study can be used as an engineering data for establishment of the national policy on spent fuel management, and the information necessary for the stakeholders who are interested in the DBD technology.

2. Technical Applicability for DBD

2.1 Deep borehole drilling and investigation technology

The current status of domestic and foreign deep borehole drilling technology was reviewed and the possible deep borehole drilling technology suitable for deep borehole disposal(diameter, depth) was analyzed. The rotary drilling, the air hammer drilling and the water hammer drilling techniques were reviewed and the applicability to the deep borehole disposal technology was analyzed. The drilling experience and the possibility are shown in Fig. 2[3].



a. Drilling experience(depth : diameter)

Depth (km)	Diameter (mm)			
	300	500	750	1000
2	G	G	G	O
3	G	G	O	O
4	G	O	O	R
5	G	O	R	R

G Possible with current technology
O Possible in the near future
R Impossible in the near future

b. Drilling possibility

Fig. 2. Drilling Experience and the Possibility.

As a part of the site suitability assessment for deep borehole disposal, the evaluation method with the geophysical exploration and the site characterization method based on geological and geo-hydrological data from geothermal industry were analyzed. In addition, the evaluation methods using the deep borehole investigation equipment owned by other institute and industry were reviewed.

2.2 Development of preliminary DBD concept

The literature survey data and the investigation data of geothermal drilling site (Pohang, Seokmodo,

Gwangju/Naju) were reviewed and the characteristics of bedrock in Korean peninsula including geothermal, age, geochemistry were analyzed.

Based on the domestic environment, the concepts of deep borehole/casing, disposal container and it's handling/operation system and preliminary borehole sealing were derived. With these unit module concepts, a preliminary reference deep borehole disposal concept was established(Fig. 3.).

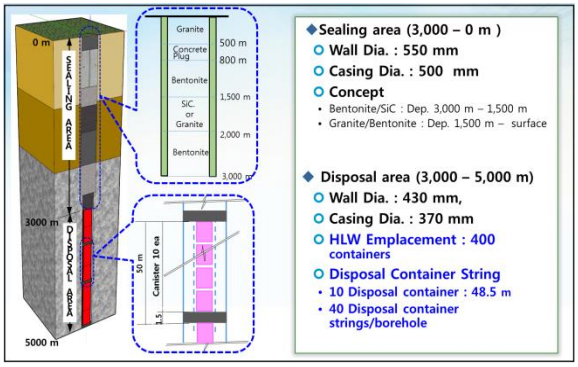


Fig. 3. Preliminary DBD Concept.

Through the preliminary thermal analysis for the established deep borehole disposal system(Fig. 4.), the distance between the deep boreholes was determined. With these results, the deep borehole disposal system layout was derived and compared with the deep geological disposal concept in terms of disposal area. In addition, a graphic disposal environment was constructed and a computer graphical simulation for the deep borehole disposal process was performed.

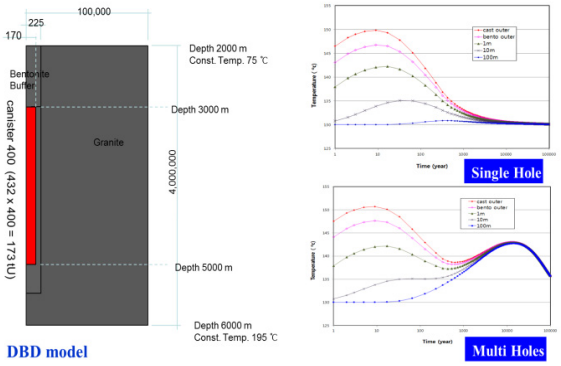


Fig. 4. Thermal Analyses for the DBD Concept.

2.3 Preliminary DBD System Evaluation

The legal basis and the basic requirements for the safety of the deep borehole disposal were analyzed and the thermal/structural stability assessment method of the disposal container and disposal system in the disposal environment was established. The basic test of granite powder melting for the evaluation of the borehole sealing performance was carried out. In addition, preliminary criticality analysis of disposal container and disposal systems was performed, and preliminary safety assessments using the result of thermal - hydraulic calculation of deep borehole disposal system were conducted.

3. Concluding Remarks

Based on the results of analysis on domestic nuclear environment, geology and industrial environment, preliminary analyses on applicability of deep borehole disposal technology including domestic geological environment, deep borehole drilling and investigation technology, concept development technology and safety assessment technology were carried out. Although the concept of deep borehole disposal is considered to be advantageous in terms of safety and economic feasibility due to disposal method and depth, it is absolutely necessary to demonstrate the key technologies and safety for practical application.

The results of this study can be used as an input data for establishment of national policy on spent fuel management, and can be used as the information necessary for the various stakeholders who are interested in the deep borehole disposal technology

ACKNOWLEDGEMENT

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