

Alternative Concepts of Deep Geological Disposal for Spent Fuels

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1. Introduction

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 there are lots of methods as alternative concepts to the KBS-3V(Vertical) type deep geological disposal technology which is considered as a reference concept and currently under the stage of licensing. They can be KBS-3H(Horizontal) type disposal concept and deep geological disposal system after long-term storage. In this study, reference disposal concepts for two types of spent fuels were described and two types of disposal concepts as alternative concepts were developed and analyzed preliminarily.

2. Disposal Concept for Spent Fuels

According to the Site specific activity, engineering design development was shown in the Figure 1.

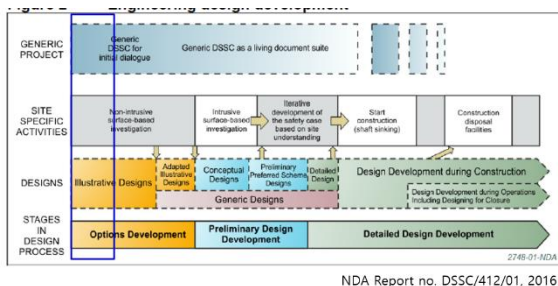


Fig. 1. Engineering Design Development.

2.1 Reference Concepts

A reference deep geological disposal concepts for PWR spent fuels and CANDU(PHWR) spent fuels were shown in the Figure 2. The thermal analyses for

the disposal systems to check the design requirement were carried out and figure 3. Showed the results the analyses.

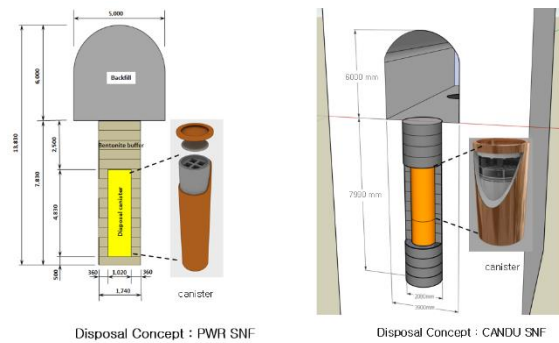


Fig. 2. Reference disposal concepts.

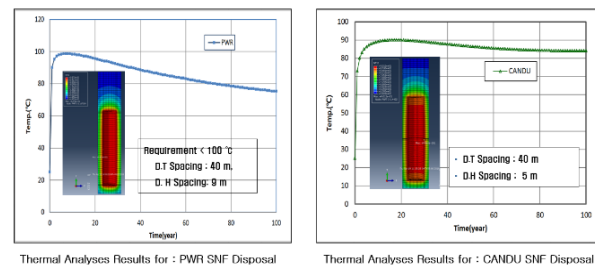


Fig. 3. Thermal analyses results for reference concepts.

2.2 Alternative concepts

2.2.1 KBS-3H. A KBS-3H type disposal concept was horizontal type disposal concept. In this concept, a Super-container which was combined with bentonite block was emplaced in the disposal tunnel horizontally. Figure 4 showed the concept of Super container and Figure showed the disposal tunnel concept with super-container.

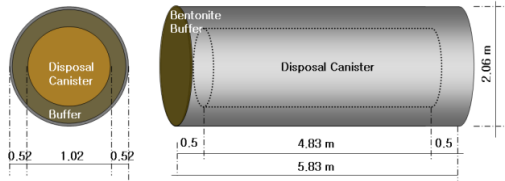


Fig. 4. Super-container concept.

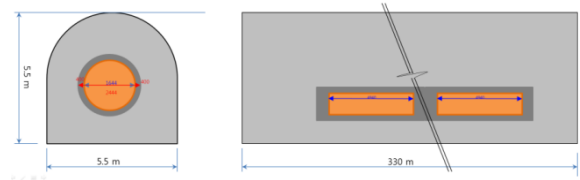


Fig. 7. Disposal concept after long-term.

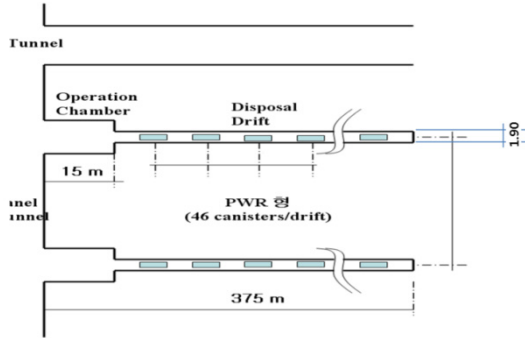


Fig. 5. KBS-3H type disposal concept.

2.2.1 Disposal concept after long-term storage.

Another alternative disposal concept can be the deep geological disposal after long-term decay storage for the spent fuels. Figure 6. showed a concept of disposal canister which had the capacity of 21 PWR spent fuels.

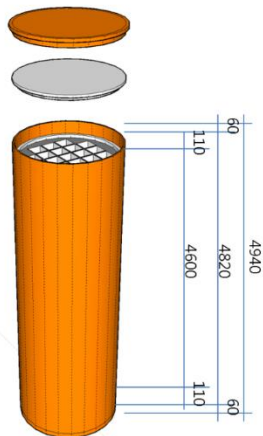


Fig. 6. 21-PWR spent fuels disposal canister.

With this 21-PWR disposal canister, firstly, the canisters were stored during about 200-300 years to reduce the decay heat. After then, the disposal tunnel would be backfilled and closed with plugs. Figure 7 showed the disposal concept after long-term storage.

3. Conclusion

There are lots of methods as alternative concepts to the KBS-3V(Vertical) type deep geological disposal technology which is considered as a reference concept and currently under the stage of licensing. They can be KBS-3H(Horizontal) type disposal concept and deep geological disposal system after long-term storage. In this study, reference disposal concepts for two types of spent fuels were described and two types of disposal concepts as alternative concepts were developed and analyzed preliminarily.

The results of this study can be used as an input data for establishment of national policy on spent fuel management.

ACKNOWLEDGEMENT

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REFERENCES

- [1] NDA, DSSC/412/01, NDA report (2016).
- [2] SKB, Final Storage of Spent Nuclear Fuel-KBS-3, SKB, Sweden (1983).
- [3] US DOE, Yucca Mountain Science and Engineering Report, DOE/RW-0539-1, US DOE (2002).
- [4] E.L. Hardin, D. J. Clayton, et al., Preliminary Report on Dual-Purpose Canister Disposal Alternatives, SNL, FCRD-UFD-2013-000171 Rev.1, (2013).