

Nuclear Criticality Analyses for Disposal Systems with Two Different Canisters

Hyungju Yun*, Manho Han, Seo-Yeon Cho, Mijin Kwon

Korea Radioactive Waste Agency, 174 Gajeong-ro, Yuseong-gu, Daejeon 34129, Republic of Korea

* yhjnet1@korad.or.kr

Keywords : Nuclear criticality analysis, Burnup credit, Disposal system, KBS-3 canister, STAD canister



KORAD
한국원자력환경공단

Introduction

- A spent nuclear fuels (SNFs) disposal system requires an accurate nuclear criticality analysis (NCA) considering burnup credit (BUC).
- The NCAs considering burnup credit were performed for KBS-3V disposal system containing two different disposal canisters:
 - ① the KBS-3 canister of Finland Posiva and Sweden SKB and
 - ② the STAD canister of U.S. Department of Energy.

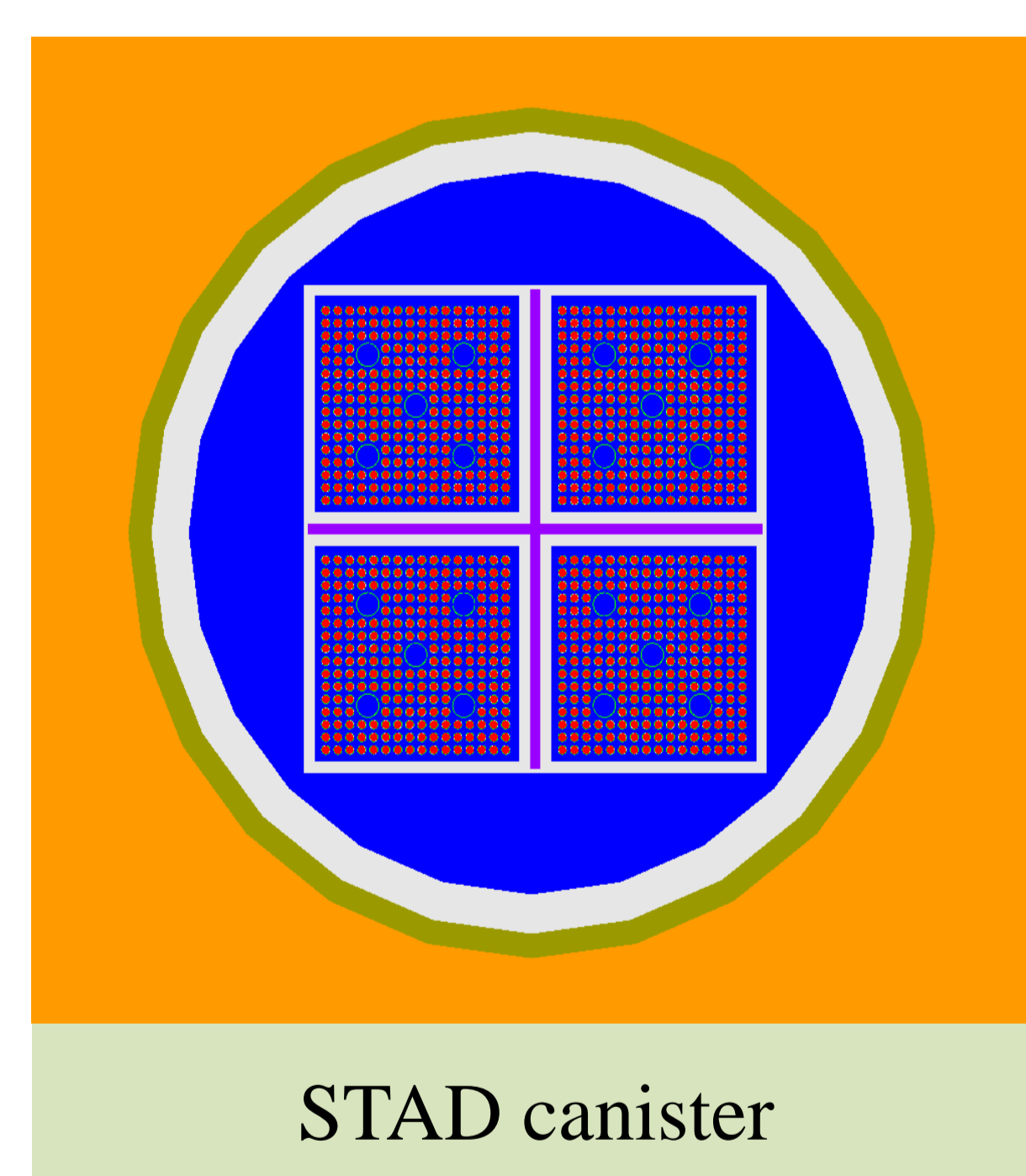
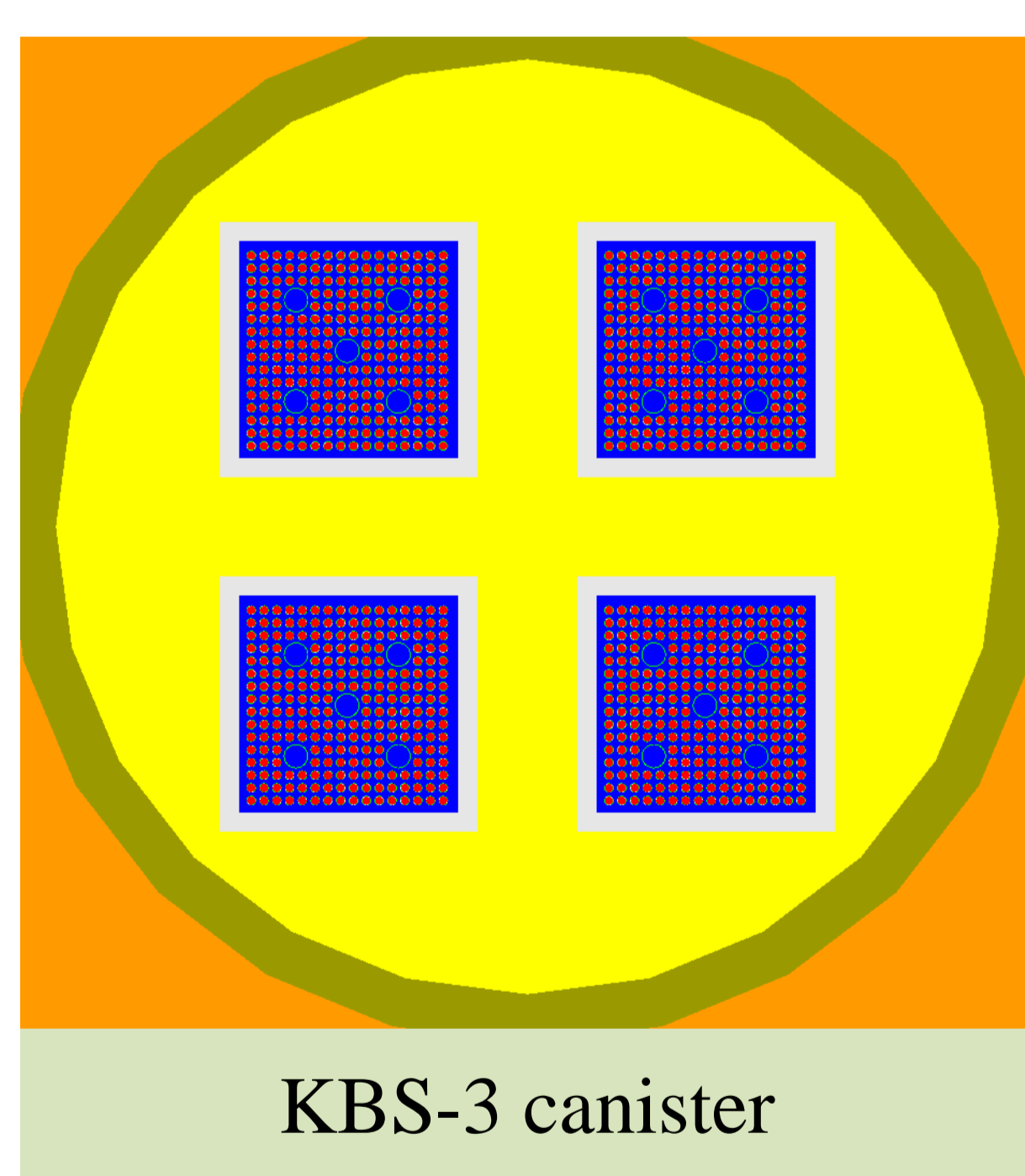
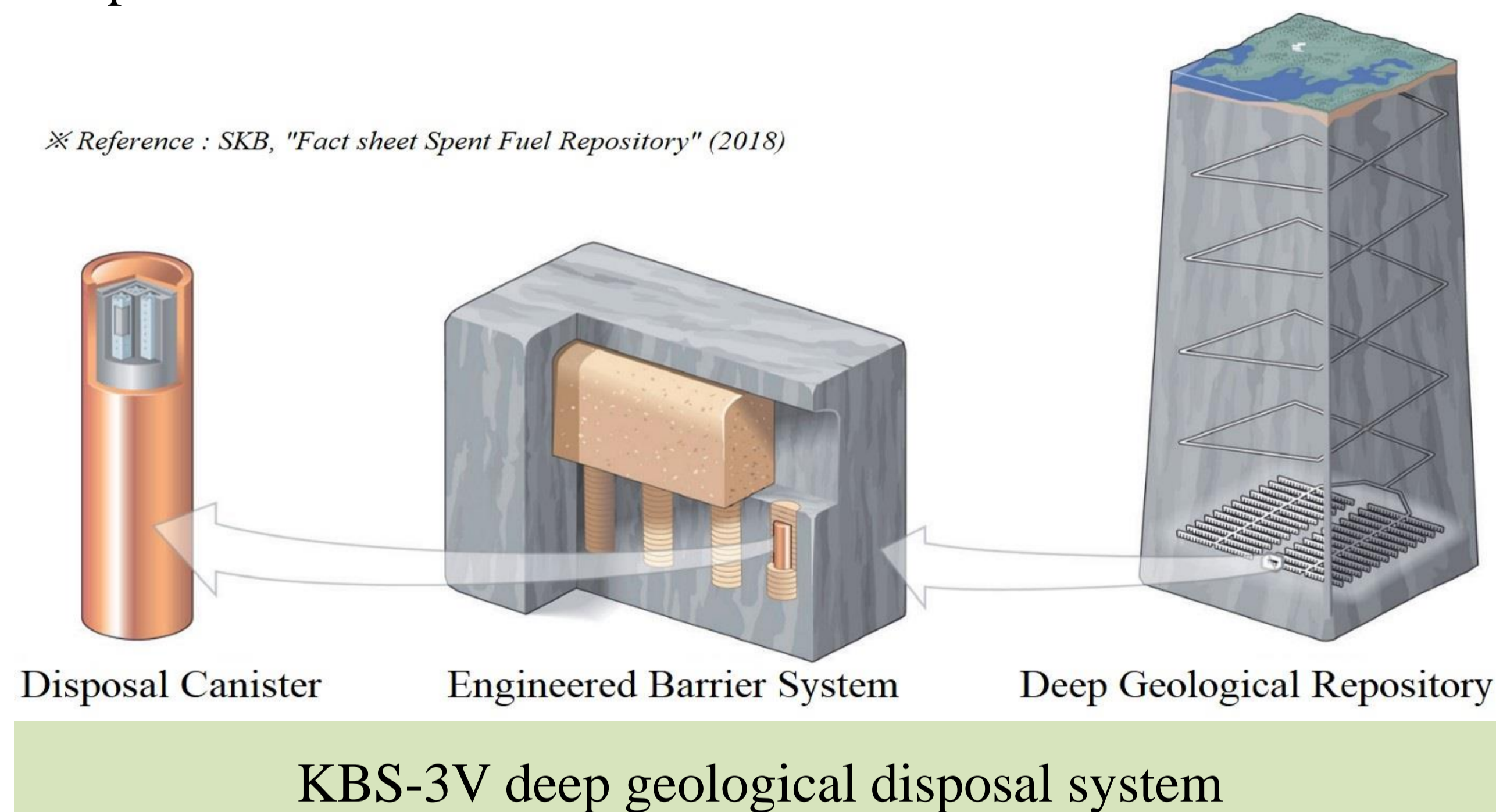
Analysis Method

- The NCAs considering BUC were carried out by the following steps:
 - ① the generation of the nuclear reaction XS libraries of SNFs,
 - ② the calculation of the isotopic compositions within SNFs,
 - ③ the assessment of the effective multiplication factor (k_{eff}) of the disposal system, and
 - ④ the evaluation of whether the k_{eff} value do not exceed 0.95.

Modelling Processes

- Computational code: SCALE 6.1/STARBUCS

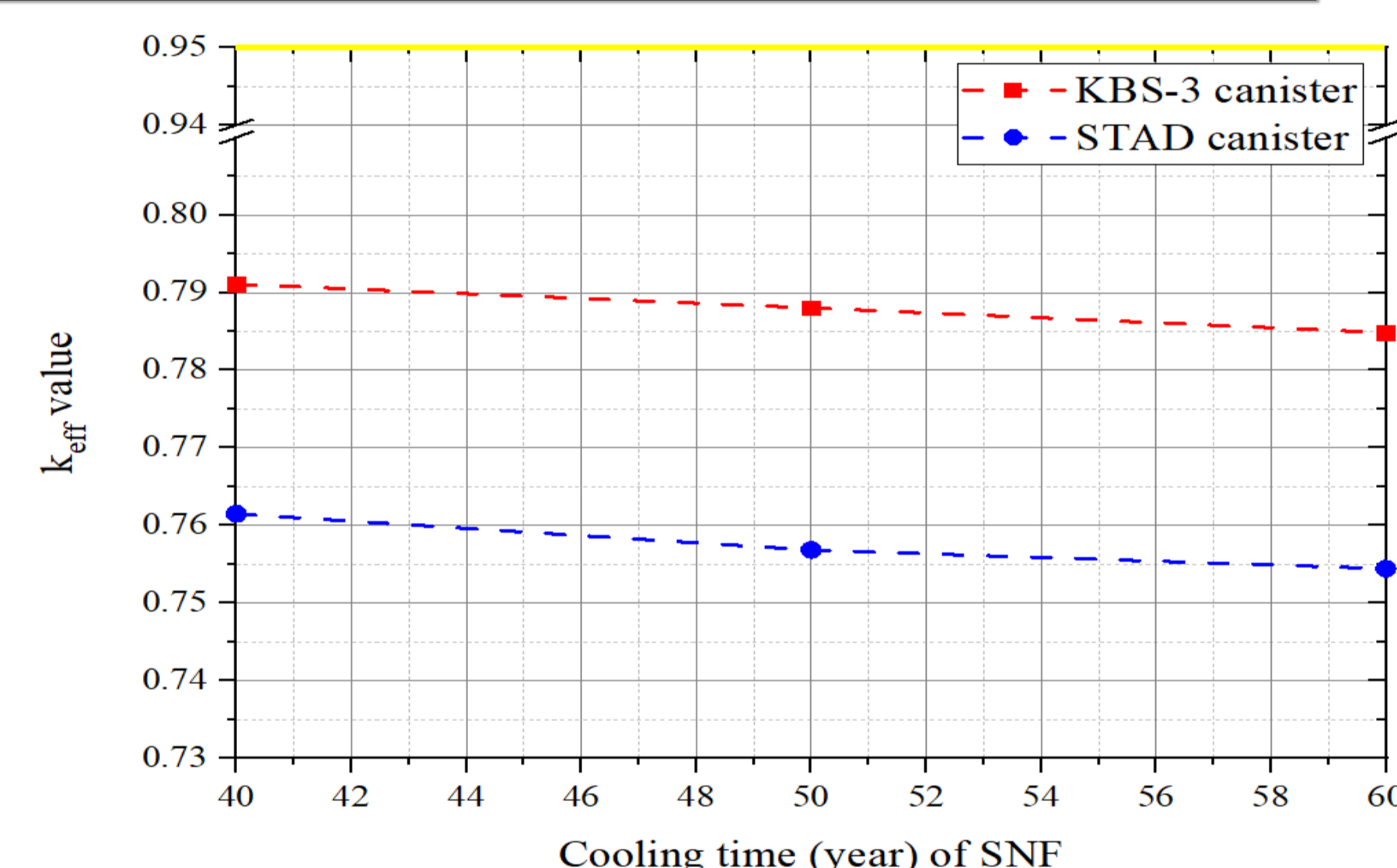
※ Reference : SKB, "Fact sheet Spent Fuel Repository" (2018)



Calculation Results

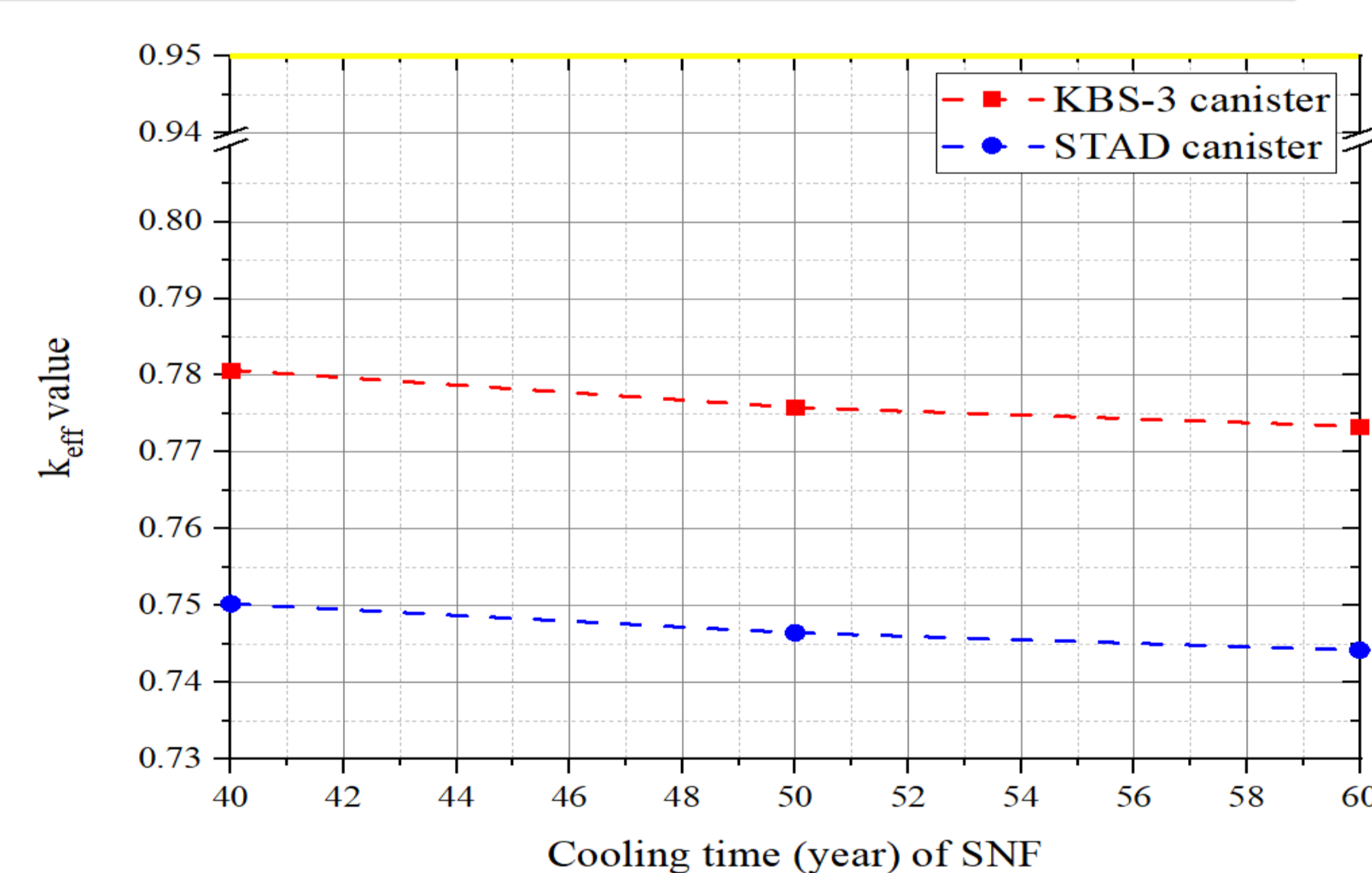
- For the SNFs of the initial enrichment of **4.0 wt. % U-235** and discharge burnup of **45,000 MWD/MTU**,

Case 1 : KBS-3 canister & Case 2 : STAD canister



- For the SNFs of the initial enrichment of **4.5 wt. % U-235** and discharge burnup of **55,000 MWD/MTU**,

Case 3 : KBS-3 canister & Case 4 : STAD canister



Conclusion

- All of four cases met the design requirement that the k_{eff} value of the disposal system should not exceed 0.95.
- All k_{eff} values for the disposal system with the higher burnup SNFs were lower than those with the lower.
- The disposal system containing the STAD canister had lower k_{eff} values than that of the KBS-3 canister.
- Because the neutron absorber plates in the STAD canister had a significant effect on the decrease of the thermal neutron flux and the corresponding k_{eff} values although the distance between the SNFs in the STAD canister was much shorter than that of the KBS-3.

Acknowledgements

This work was supported by the Institute for Korea Spent Nuclear Fuel (iKSNF) and Korea Institute of Energy Technology Evaluation and Planning (KETEP) grant funded by the Korea government Ministry of Trade, Industry and Energy (MOTIE) (No. 2021040101003C).