A Study on the Trend of Storage Casks of Generation depend on the Cutting Angle PWR Reactor Vessel Internals

Hyo-Jeon Kim [a]*, Jae-yong Lee [a], Kyung-min Kim [a], Dong-jun Lee [a], You-jin Kang [a], Hoa Kim [a], Min-seung Ko [a]
[a] *Department of Nuclear Engineering, Hanyang University, 222 Wangsimni-ro, Seongdong-gu, Seoul, Republic of Korea*
**Corresponding author: yongskim@hanyang.ac.kr*

1. Introduction

It is expected that about 80,000 drums of waste will be generated when Kori Unit 1 is decommissioning [1]. As of January 11, 2022, the cost of managing and disposing radioactive waste is 15.11 million won per 200 l drum [2]. The goal is to reduce this waste to 14,500 drums through classification, decontamination, and recycling. The Reactor Vessel Internals (RVI) must be disposed of through cutting and storage because decontamination is impossible. It is irradiated by neutrons for a long time. The detailed disposal standards for intermediate-level radioactive waste are still being discussed in Korea [3]. This poster shows the storage of RVI intermediate-level components in MOSIAK casks.

2. Cutting Conditions

2.1 Components Scale

The core barrel is 45mm thick, about 2,770mm in diameter, and 2,850mm in height. The thermal shield is 89mm thick, about 2930mm in diameter, and 2,650mm in height.

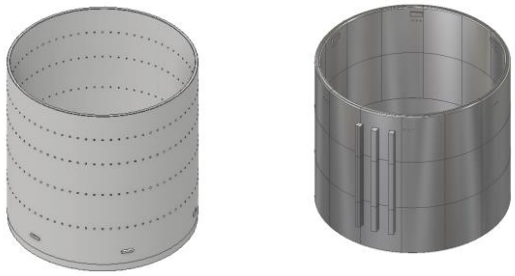

Fig. 1. Core barrel & Thermal shield

2.2 Structure Classification

According to previous studies, the dose is higher at the center of the nuclear reactor and closer to the nuclear fuel, and the core barrel and thermal shield correspond to the intermediate level [4, 5, 6].

2.3 Cutting Technologies

Cutting technologies include plasma arc cutting and band saw cutting according to the material and thickness of the cutting object. Plasma arc cutting is fast, but the cut thickness is limited. The band saw cutting is slow, but it can cut up to 200mm.

2.4 Storage container (MOSAIK Cask)

Germany used the MOSAIK cask when disposing of intermediate-level waste from the Stade nuclear power plant (630Mwe, PWR). This model can be loaded underwater.

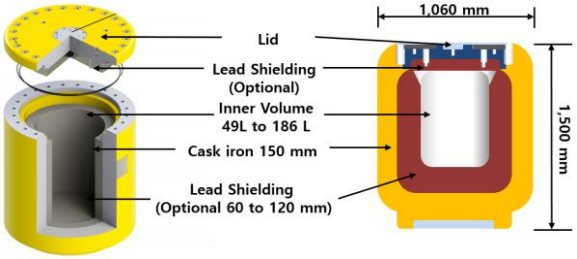

Fig. 2. MOSAIK cask shape

Table I: MOSAIK Cask Scales [7]

MOSAIK	M II-15 U EI*
	Type U (U)
Outer height (mm)	1500
Outer diameter (mm)	1060
Internal height (mm)	1140
Internal diameter (mm)	740
Wall thickness (mm)	160
Lead shielding (mm)	0-120
Empty weight app (kg)	5730-9230
Volume max (dm^3)	165-490

3. Division into equal or Angle parts

It aims to reduce the number of generated storage containers and, at the same time, reduce the working time. Although the shape of the cut product differs depending on the shape of the container, if a cylindrical storage container is used, the number of storage containers and the cutting time that occur by the cutting method for each angle can be reduced compared to the equal cut. The table shows the number of storage containers generated when cutting up to 50 equal parts and the number of storage containers generated when cutting into angle parts.

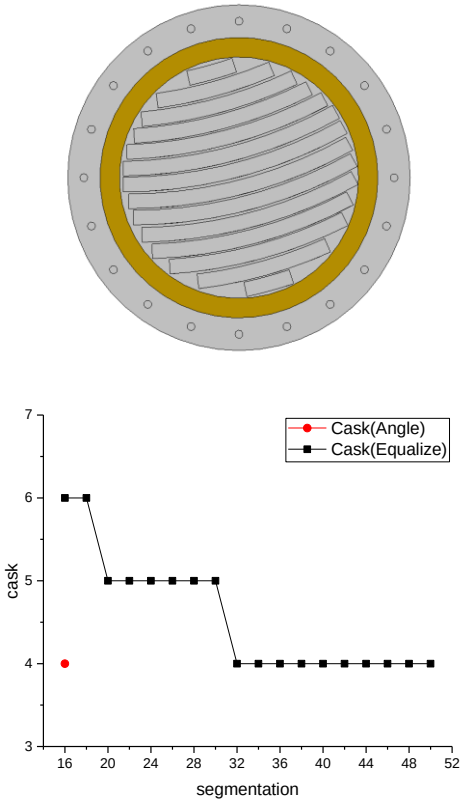

Fig. 3. Core barrel cutting angle and equalize

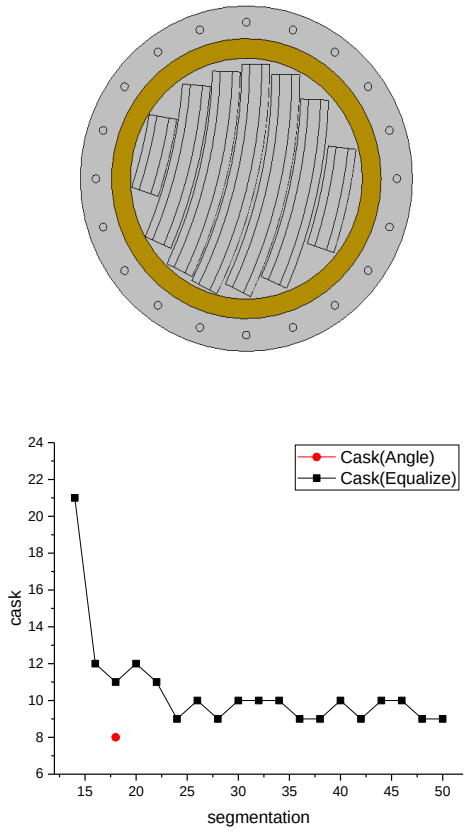

Fig. 4. Thermal shield cutting angle and equalize

4. Conclusions

Among the parts of PWR RVI, in the case of the core barrel, the number of storage casks generated when cutting into 16 - 50 equal parts is 6 to 4. It is possible to reduce two storage containers compared to the same work time with four storage casks when cutting by angle. In the case of the thermal shield, when cutting into 14 - 50 equal parts, 21 to 9 storage containers are generated, but when cutting at each angle, one storage container is saved, and the cutting time can be significantly reduced. It is ideal for saving waste, time, and money for successful decommissioning.

Acknowledgment

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government NRF-2019M2C9A1057808 and NRF-2017M2B2B1072888

REFERENCES

[1] Coates, R., et al. Managing Low Radioactivity Material from the Decommissioning of Nuclear Facilities. No. 462. IAEA, Technical Reports Series, 2008.
[2] 산업통상자원부, 방사성폐기물 관리비용 및 사용후핵연료 관리부담금 긍의 산전기준에 관한 규정, 2022.
[3] KORAD, 2021 년 중 저준위 방사성폐기물 관리 시행계획, 2021.
[4] Jung, Duk-Woon, et al. "A Study on the Conceptual Design of Package for the RV/RVI Cutting Wastes During Decommissioning of Kori Unit-1 NPP." 한국방사성폐기물학회 학술대회 (2018): 289-290.
[5] Volmert, Ben, et al. "Illustration of Nagra's AMAC approach to Kori-1 NPP decommissioning based on experience from its detailed application to Swiss NPPs." Nuclear Engineering and Technology 53.5 (2021): 1491-1510.
[6] Rossini, Stefano, et al. "Radiological characterization of the reactor pressure vessel of Trino NPP for dismantling purposes." Progress in Nuclear Energy 107 (2018): 17-30.
[7] GNS. MOSAIK casks – A Comprehensive Solution for Packaging ILW, (2019): Paper 1157