Development of PHWR Spent Fuel Storage Basket Cutting Equipment

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1. Introduction

Wolseong heavy-water spent fuel dry storage facility stores approximately 322,000 bundles of spent fuel bundles from 1992 to the end of September 2020, and further construction of the MACSTOR/KN-400 storage facility is expected to increase its spent fuel storage capacity(Total : 498,000). Basically, 60 bundles of spent fuel are loaded into a storage basket, and the basket is sealed by welding and stored in a dry storage facility, but no equipment has been developed with domestic technology to dismantle PHWR spent fuel storage basket. Therefore, this paper aims to describe the cutting equipment of PHWR spent fuel storage basket developed with domestic technology.

2. Development of Cutting Equipment

60 bundles of PHWR spent fuel are loaded into a storage basket, and the basket is sealed by welding and stored in a dry storage facility. Basket cutting equipment is designed as an integral part for ease of installation and cutting precision of the basket to be cut, and the operator is manually remotely operated on the work platform outside the reservoir.

2.1 Basket Cutting Equipment Configuration

It is a cutting equipment that integrates turntable and two-way cutting device structures that can be transported and rotated into the main body. The basket cutting process is carried out with two cutting method: cutting the bottom of the basket horizontally and cutting the top of the basket vertically. Use end mill as a cutting tool. Both cutting tools are driven by an air motor, and the adjustment of the cutting depth is controlled remotely by the operator outside the reservoir, and the cutting speed of the basket are controlled by rotating on the rotating table. The rotation direction and speed of the rotating table are remotely controlled from the out-of-store operation platform, and the control method is manual only. Specifications for major components such as air motor, rotary index, end mill, side cutter, and ball screw were selected after reviewing the pre-function test of a single item in detailed design. The structure and specifications of the basket to be cut are shown in Figure 1 in the sectional diagram of the fuel basket. When cutting a basket to be cut in the reservoir, the cutting equipment shall not damage the spent fuel inside the basket under any circumstances, and an underwater camera may be used to verify it in real time.

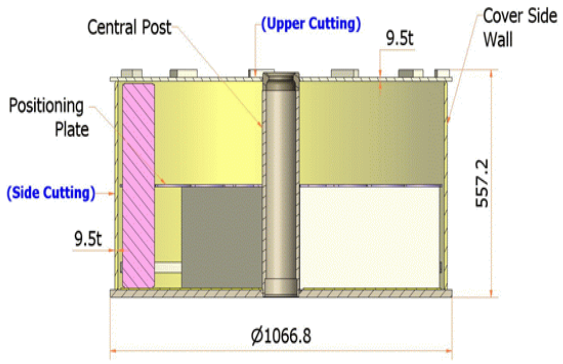

Fig. 1 Basket Sectional Plot

Figure 2 shows a conceptual diagram of the basket cutting equipment. The main characteristic of basket cutting equipment is the easy loading of the basket to be cut. In other words, an all-in-one turntable that can be transported back and forth is designed to prevent interference caused by loading the cut target basket into cutting equipment. By applying an integrated structure of turntable and cutting equipment, it is easy to settle and secure the basket, and it significantly improves worker convenience. Figure 3 shows the concept of a transport device for a basket cutting equipment.

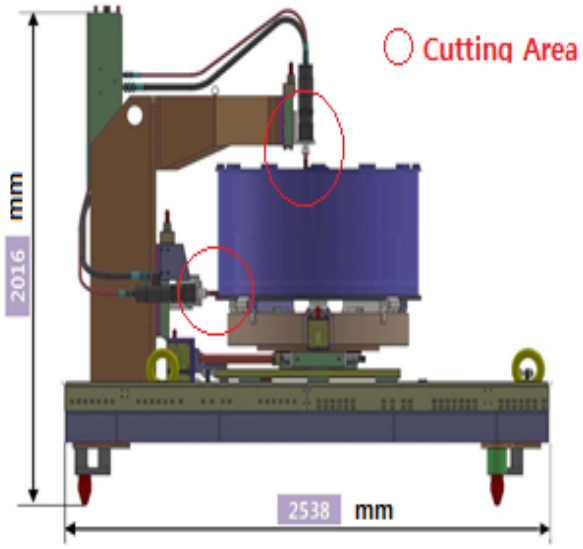

Fig 2. Design of Cutting Equipment

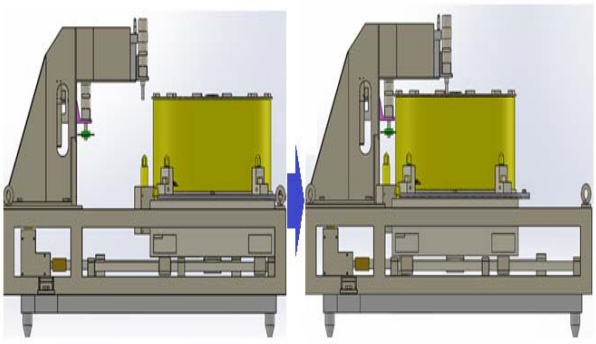

Fig 3. Transport Concept of Basket

2.2 Demonstration Test of Basket Cutting Equipment

After completing the construction of PHWR spent fuel basket cutting equipment, an empirical test was conducted to cut the basket under conditions similar to the spent fuel pool. PHWR spent fuel storage basket cutting equipment was installed on platforms of similar height considering in-Bay work table in the spent fuel pool for verify the equipment. As the result of test, The more chips than expected occurred when cutting the side part of the basket, but did not disperse out of the equipment due to the side cover installed to prevent chip scattering in the lower base frame. It took about seven hours for the basket to rotate once at the initial position of the side cut, and after one turn, the basket was taken out of the test facility and checked. We confirmed that the side of the basket was properly cut. There were more chips than expected when cutting the welding area on the top of the basket, but the chips were not scattered out of the equipment as they were piled up on the cover of the basket. It took about two hours for the basket to make a single turn, and it was cut to a thickness of about 3mm. We confirmed that the cutting was carried out properly.

3. Conclusions

It is confirmed that the basket cutting equipment is integrated into a transportable tentable and cutting structure to be cut reliably and accurately. In particular, it was confirmed that the basket was easy to settle and fix, and that cutting precision and safety were secured in the demonstration test of cutting in a water bath similar to the working environment in the nuclear power plant. The developed cutting equipment will be used for dismantling the basket, which is required for the long-term integrity assessment of spent nuclear fuel, in the future.

REFERENCES

[1] IAEA Safety Standard, No. SSR-6, “Regulations for the Safe Transport of Radioactive Material”, 2012

[2] US 10 CFR 71, “Packaging and Transportation of Radioactive Material”, 1996.