Conceptual Design Hybrid Cutting System for Type B Radwaste

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1. Introduction

ITER is an international research and development project which aims to demonstrate the scientific and technological feasibility of fusion power. The ITER tokamak is being constructed in Europe, at Cadarache in southern France. As part of the ITER project, dismantling methods and systems are being developed for treatment of the radioactive waste. The replacement of in-vessel components, such as divertor cassette assemblies and blanket first walls, will result in the generation of large metallic Type B (intermediate-level and long-lived or MAVL "Moyenne Activité et durée de Vie Longue" in French) radioactive waste.

Doosan Heavy Industries (DHI) supported the ITER Organization (IO) with development of a conceptual design of a hybrid cutting system for the Type B radwaste volume reduction process. The research was supported by the ITER Korea Domestic Agency (KODA) funded by the IO.

2. Concept Design of Hybrid Cutting System

In this section, the cutting plan and design of a hybrid cutting system for Type B radwaste components is described.

2.1 Cutting Plan

In order to develop the cutting plan for divertor cassette and blanket first wall, the potential cutting locations were selected to minimize the cutting length in order to reduce cutting time and increase tool life. The following boundary conditions for the cutting plan design were provided to DHI.

- The inner size of storage box (after cutting): 1.2 m × 1.2 m × 1.2 m
- Handling/holding device capacity: max. 2 tonnes

The dimensions of divertor cassette assemblies and blanket first walls are shown in table 1. The material is primarily stainless steel. [1]

Table 1: The dimensions of the divertor cassette assembly and blanket first wall

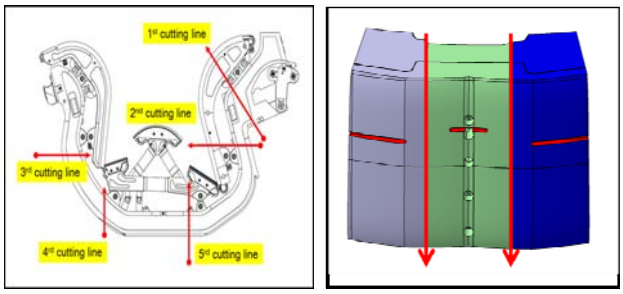
Component	Dimensions [mm]
Divertor CA	3300 × 2000 × 770
Blanket first wall	1400 × 1000 × 600

Based on the above conditions, the designed cutting lines for divertor cassette assemblies and blanket first walls are shown in fig. 1.

The shape of divertor cassette assembly is very complicated. In order to make the cutting plan, DHI studied the handling of the cut pieces, cutting method and other supporting functions.

The Type B radwaste is size reduced by mechanical cutting methods. Of the many kinds of mechanical cutting methods, DHI selected the band saw cutting method due to shape and size of the cassette assembly. [2]

In order to handle the cut pieces, DHI designed a handling device with a concept of holding holes and grooves. The concept of the holding method for divertor cassette assemblies is shown in fig. 2. The holding holes are cut by laser.



(a) Divertor cassette assembly (b) Blanket first wall

Fig. 1. Cutting lines for divertor cassette assemblies and blanket first walls

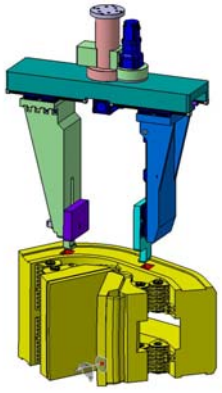


Fig. 2. Concept of holding method for divertor cut pieces

The cut piece is lifted by the handling device. In order to lift the cut piece, the fingertips of the handling device are inserted into two lifting holes and secured by clasping towards the center. Then, the cut piece is lifted by the crane-like delivery system and placed in the storage box. For the blanket first walls, groove holes for holding are machined by mechanical methods. (horizontal red line in fig. 1)

2.2 Conceptual Design of Hybrid Cutting System

DHI developed a hybrid cutting system based on the cutting plan design. The designed hybrid cutting system is shown in fig. 3. The hybrid cutting system primarily consists of a band saw cartridge, laser cutting equipment, turn table, several jigs, handling device and chip conveyor.

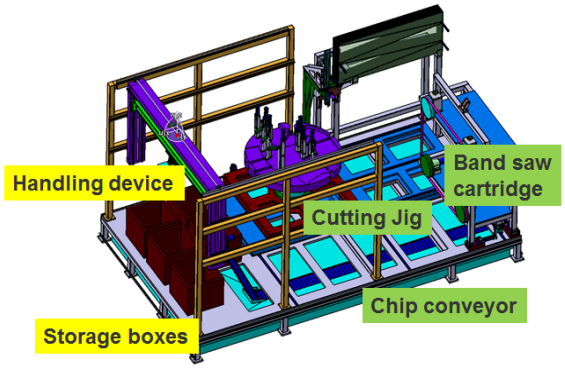
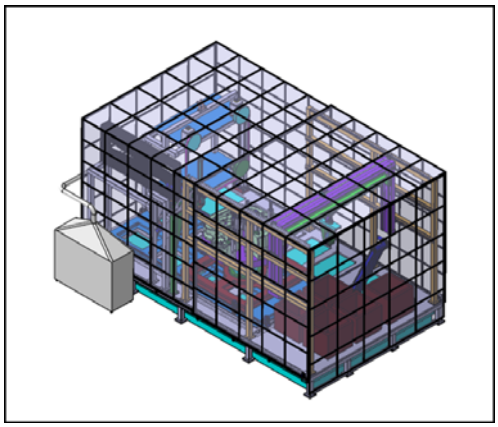


Fig. 3. Hybrid cutting system

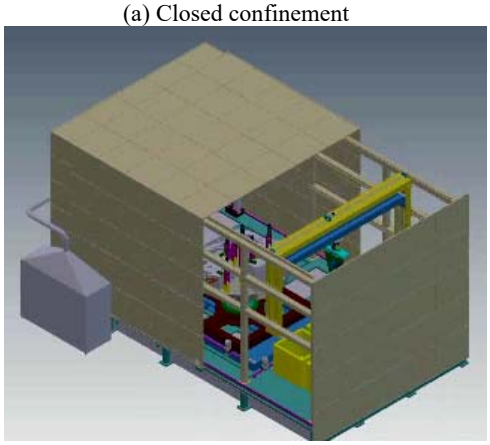
The primary cutting methods selected are band saw and laser. The laser cutting method is applied to cut the small pipes and geometries and to make the holding holes on the surface of the cut piece. The band saw method is applied to the main component on the turn table, which is fixed using several jig-like clamps. The cut piece is lifted by the handling device and placed into a storage box. The chips generated from the cutting operations are collected and transferred into a storage box by a chip conveyor.

This hybrid cutting system is fully operated by remote control. In order to control it remotely, DHI needs to resolve a key problem which is how to exchange the saw blade automatically. In the case of the band saw, the band saw blade has to be replaced periodically according to the life of saw blade. Therefore, it is planned to solve a number of problems such as saw blade exchange by manufacturing a band saw blade cutting module in the cartridge structure capable of automatically exchanging the worn band saw blades.

Fumes and aerosols are created during the cutting operations. Therefore, DHI has designed the hybrid cutting system with a closed confinement that collects the aerosols within the confinement through a fume collecting system housed outside of the confinement box. The entire hybrid cutting system is composed of three confinement sections. Each section can be slid open or closed for replacing the components to be cut. The hybrid cutting system with confinement is shown in fig. 4.



(a) Closed confinement



(b) Open confinement

Fig. 4. Hybrid cutting system with confinement

3. Conclusions

DHI developed the design of the cutting plan and a hybrid cutting system for Type B radwaste of ITER tokamak.

From this research, DHI provided a useful concept for the treatment of radwaste at ITER.

Disclaimer

The views and opinions expressed herein do not necessarily reflect those of the ITER Organization and project partners.

REFERENCES

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