Preliminary Analysis of Remote Handling Feasibility of the ITER Type B Radwaste Management System

Kwonpyo Hong [a*], Wan-Ho Oh, Dae-Seok Hong, Young-Yong Ji, Tae-Kook Kim, Sang-Bok Ahn, Wu-Seog Ryu [a], Ki-Jung Jung [b], Je-Keun Cheon, Byung-Chan Na, John Blight [c]

[a]*Korea Atomic Energy Research Institute, Daejeon, Korea*
[b]*National Fusion Research Institute, Daejeon, Korea*
[c]*ITER Organization, 13067 St Paul lez Durance Cedex, France*
[*]*Corresponding author: kphong@kaeri.re.kr*

1. Introduction

ITER Type B radwaste, which is defined as intermediate level and long lived radioactive waste, is mainly resulted from the replacement of in-vessel components of Tokamak such as divertor targets and domes and first walls of blankets, etc. They are mostly metallic components activated by neutrons and contaminated by tritium. The Type B radwaste is to be stored in ITER site for the life time of ITER. For this purpose the Type B radwaste treatment and storage system (RWTS) is located in the level 2 basement of the ITER Hot Cell Building (HCB).

2. Concept of Type B radwaste treatment

Radwaste components are transported from Tokamak building to a buffer storage area waiting the treatment process, which are cutting, tritium removal, characterization, pre-packaging, and storage as shown in figure 1.

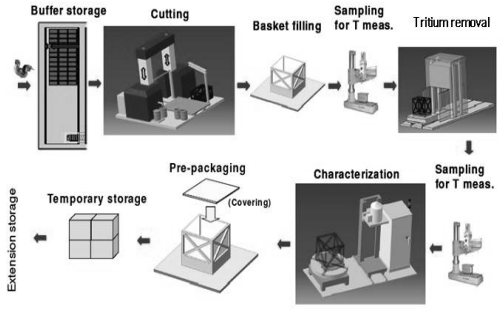

Figure 1. The concept of Type B radwaste treatment.

All process should be executed with remote handling equipment because human access is not available inside hot cell.

Cutting process

The treatment starts with the cutting operation for volume reduction. A laser cutting and a band saw cutting are considered as cutting method. Cut slices are collected into a small basket using a jib crane. Then, basket filled Type B radwaste is sent to tritium removal station. In cutting station cleaning and contamination protection of dust, dross, or fume decontamination is an important issue.

Tritium removal process

In tritium removal station, tritium embedded in Type B radwaste is removed by baking method. A remotely operative furnace will be designed in this station. Removed tritium gas is collected and dissolved in water, then sent to tritium plant at ITER site.

Before and after tritium removal a specimen is sampled for the measurement of contents of tritium inside Type B radwaste in order to verify the removal rate and residual tritium.

Characterization

In characterization station Type B radwaste passes through the characterization process. Weight and radioactivity of gamma emitting isotopes are measured. For this purpose a rotating balance and movable detector unit is to be designed. Detector signals are analyzed in a separated analysis room.

Pre-packaging

Type B radwaste is pre-packaged in this station for about 20 years of storage at the basement of HCB. A liner basket will be applied to the storage of Type B radwaste. After pre-packaging the basket will be inspected and decontaminated if necessary.

Storage

Basket filled Type B radwaste is stored in the basemen of HCB during ITER lifetime.

3. Remote Handling Feasibility

All the processes of Type B radwaste treatment have to be performed by remote operation. Maintenance of each process equipment and service equipment are also performed remotely. For this, several remote handling

equipment are designed in red zone of HCB basement, which are cranes, power manipulators, and trolleys.

The specifications of the remote handling equipment are listed on Table 1.

Table 1. Remote handling equipment for Type B Radwaste treatment & storage

Station	Crane	Trolley	Power Manipulator
Buffer storage	40/5 ton	40 ton	-
Cutting station	20/5 ton	30 ton	1 ton (200kg)
TRS			
Characterization			
Pre-packaging	20/5 ton		1 ton (200 kg)
Temporary storage	20/5 ton	-	-

Operation and control room of remote handling equipment and process equipment is located in the neighboring Personnel Access Control Building (PACB).

Maintenance concept of remote handling equipment

There are three categories in maintenance scheme, which are in-situ maintenance of process equipment, maintenance of process equipment in repair room, and maintenance of remote handling equipment itself.

For the in-situ maintenance, using only remote handling equipment such as power manipulators the process equipment is repaired. It includes exchange of consumables such as exchange of contaminated filters, band saws and so on.

Meanwhile, the process equipment is moved to repair room in case of repair room maintenance. The process equipment is dismantled first then moved to decontamination room using cranes and trolleys. After decontamination which is performed remotely, dismantled equipment is repaired manually. Therefore all process equipment is designed to be available in remote dismantling. Three repair rooms are allocated in basement of HCB for this purpose.

If a remote handling equipment itself has trouble, it should be transported to repair room too. The rails are extended to repair room to carry the remote handling equipment into repair room. A specially designed unlocking system is applied to the remote handling equipment in preparation of driving power failure.

3-D simulation of Type B radwaste treatment process

In order to check the validity of remote operation of each process three dimensional simulation has been performed. Three dimensional modeling was built with the base of current design concept by using CATIA program, and simulation of dynamic process was performed to visualize the reality of each process. This 3-D simulation will be updated according to the progress of more detail design.

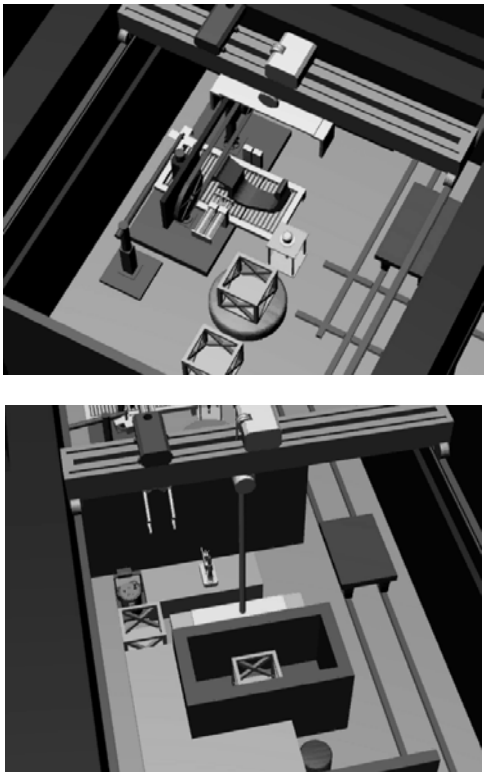

Figure 2. 3-dimensional simulation of each process – cutting(upper) and tritium removal(lower)

4. Conclusion

Remote handling feasibility on ITER Type B radwaste treatment and storage has been studied and optimized processes were set up in HCB basement. To perform the remote operation and maintenance of each process the remote handling compatibility was studied. 3-D simulation of Type B radwaste treatment was also performed to verify the applicability of each remote process. The results will be applied to further detail study.

Acknowledgement

This study was supported by ITER Organization and ITER Korea of National Fusion Research Institute.

References

[1] Description of ITER Radwaste Treatment and Storage System Designs (ITER_D_2NPB37)
[2] System Design Description 62-21 Hot Cell Building (ITER_D_2FD95Z)