

Needs and Goals of Pyroprocessing Automation Verification Mockup

Dongseok Ryu*, Jongkwang Lee, Sungwook Kim, SungJai Lee, Jin-Mok Hur, and Hyojik Lee

Korea Atomic Energy Research Institute, 989-111 Daedeok-daero, Yuseong-gu, 34059 Daejeon, Republic of Korea

*sayryu@kaeri.re.kr

1. Introduction

KAERI (Korea Atomic Energy Research Institute) have extensively studied on the pyroprocessing, and several facilities have been prepared for the relevant experiment, such as PRIDE and ACPF [1, 2]. The facilities mainly focuses on the radioactive experiments. However, troubles comes not from the radioactive treatment, but from the mechanical reliability due to high temperatures or molten salt. The facilities shows limitations and inconveniences to simple and quick test of the equipment design for the mechanical reliabilities. This research propose a new experimental space, PAVM (Pyroprocessing Automation Verification Mockup), dedicated to evaluate the mechanical feasibility of equipment including automation function.

2. Pyroprocessing automation verification mockup

2.1 Needs and goal

The pyroprocessing is composed of dozens of sub-processes, and many pieces of equipment for the sub processes are closely interacted each other. To evaluate each piece of the equipment, argon or dry air environment are required, because the equipment utilizes the molten salt, which is extremely corrosive when it binds to oxygen. A glove box is enough for the small size equipment. A large processing room or cell should be prepared to experiment on the large

size equipment. If radioactive material is investigated in the equipment, the way to shield should be additionally considered. KAERI prepares all spectrums of experimental setups for pyroprocessing, as listed in table 1.

Table 1. Features of facilities in KAERI

No	PRIDE	ACPF	Glove boxes
Radioactive area	O (simfuel)	O (spent fuel)	O
In/export	difficult (argon)	strictly managed	convenient
Removing used equipment	difficult (large size)	prohibited (high level waste)	not easy
Access and operation	difficult (argon)	difficult (radiation)	convenient
Size of equipment	large	small	small

In the existing facilities, many trials and errors were happened during operation, and one important lesson was learned; the most suspending of experiment comes usually from the mechanical failures, not from a processing failure or the radioactive trouble. This means the mechanical reliability of empirical equipment, such as high temperature endurance, corrosion resistance against molten salt, remote operability and automation function, has highest priority in the equipment design. The mechanical reliability should be prepared in prior to the radioactive experiment, and a specialized experimental space are essential to dedicated for the mechanical issue.

To meet the raised new needs, PAVM is proposed to accomplish two goals, as below.

- ◆ Evaluation of mechanical reliability
 - Exclude radioactive test
 - Dedicate to equipment behavior in high temperature, molten salt, high electricity
- ◆ Evaluation of automation function
 - Automated loading/unloading crucibles, automated basket transportation, quick replacing modules and filter cartridges, etc.

- Convenient access of human operator
- Air tight, large window, etc.
- ◆ Remote-handling automation system
 - Gantry robot for basket transportation
 - Modular design of sensor and actuator

Fig. 2 shows the conceptual drawing.

2.2 Preliminary requirements

Pyroprocessing is actually done by series of equipment. If small empirical space for two pieces of equipment are available, and if one section from the series process were proved with the previous and the following equipment, and if the section results were successively extended, then the full process can finally be evaluated from the small empirical space.

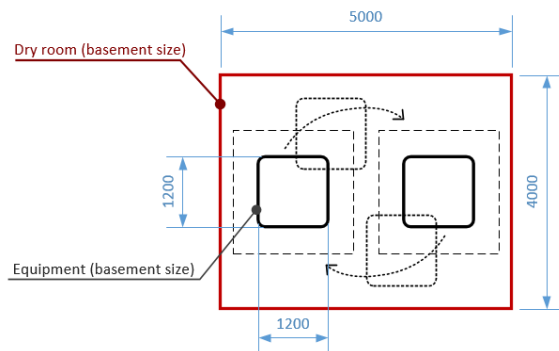


Fig. 1. Sample Figure.

Therefore, the PAVM was sized enough to accommodate two pieces of equipment, as shown in Fig. 1. The basic dimension (1200 mm x 1200 mm x 1500 mm) of equipment was determined in the consideration of 1.5 kg uranium reduction.

The very basic requirements for PAVM were listed below.

- ◆ Dry room
 - Enough space for two pieces of equipment
 - Dry air regulation with dew point -40C

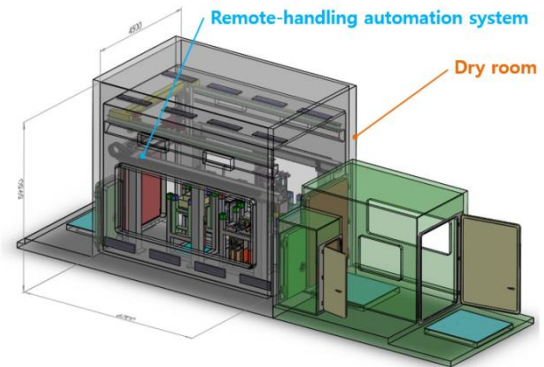


Fig. 2. Conceptual drawing of the PAVM.

3. Conclusion

The pyroprocessing automation verification mockup was proposed to provide experimental space dedicated to the mechanical feasibility of equipment, including automation function. Background of the PAVM was described, and the needs and goals were defined. The basic requirement of the PAVM were shown in this research.

REFERENCES

- [1] Dongseok Ryu, et al. "Development of a Virtual 3D Simulator to Evaluate Remote Operations in PRIDE," Proc. of ANS 2016 Tropical meeting D&RS, pp. 3-6 (2016).
- [2] Dongseok Ryu, et al. "Virtual Verification using 3D Simulator for a Remote Operation Procedures in PRIDE," Proc. of 2016 IPRC, p. 66 (2016)