

Improvement of Maintenance Method for the Three Piece MSM

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1. Introduction

Korea Atomic Energy Research Institute (KAERI) has built a pyroprocess test facility as a mock-up to develop pyroprocess technology. PRIDE uses a remote handling device to operate the process equipment installed in the work cell. The remote handling device is equipped with a BDSM (Bridge transported Dual-arm Servo Manipulator), a crane and master-slave manipulator (MSM). This paper describes the procedures for removing and repairing a manipulator when a master-slave manipulator failure. I will describe the development of a repair tool that improves the procedure and time to repair a specific fault in the manipulator.

2. Outline of PRIDE facility

2.1 Composition of PRIDE facility

Pride facility is a cell filled with an argon. The argon cell should be able to operate the process unit in an argon atmosphere and should not leak out. 34 master slave manipulators are installed on the front of the cell. Inside the cell, devices for electrolytic reduction, electrolytic recovery, and waste treatment are installed. All operations are subject to process operation and maintenance using remote handling devices and tools. There are LTL (Large equipment Transfer Lock system) and STL (Small equipment Transfer Lock system) devices for material import and export.

2.2 Configuration of Master Slave Manipulator

The mechanical MSM installed in the mockup consists of three parts: a slave arm, a through tube, and a master arm as shown figure 1. The MSM unit has the function of sealing the inside and the outside of the cell through a through tube installed on the wall of the argon cell. The slave arm of the MSM installed in the mockup is installed inside the cell. The through tube is installed on the wall of the mockup. A master arm is installed outside the cell. The MSM installed in the hot cell has a one-piece type and a three-piece type. The one-piece manipulator can't be separated into one body. The three-piece manipulator can be separated three bodies.

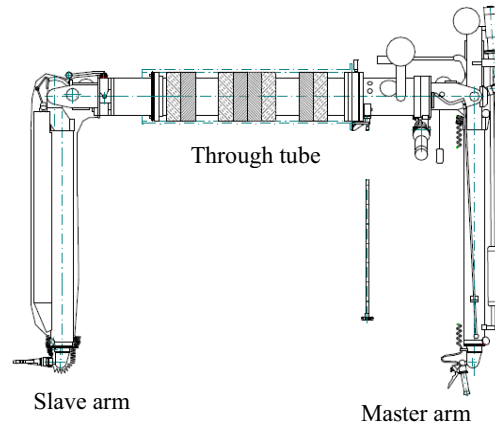


Fig. 1. Configuration of master-slave manipulator.

3. Repair of master-slave manipulator

3.1 Repair procedure of master-slave manipulator

The 3-piece manipulator can be separated into the three parts. If the slave arm of the 3-piece manipulator fails, the slave arm is detached from the through tube. The separated slave arm is taken out of

the cell. The surface of the arm and booting is decontaminated. Repair technician repairs the faulty part of the slave arm. The repaired slave arm is carried into the cell. The worker connects the slave arm to the through tube.

If the master arm fails, the worker separates the master arm and the slave arm or only the master arm from the through tube according to the fault location. The slave arm is separated and taken out of the cell and decontaminated. Repair technician repairs the faulty part of the master arm. The coupling position of the slave arm is adjusted to the position so that it can engage with the master arm and is carried into the cell. After connecting the master arm to the through tube, the worker connects the slave arm to the through tube.

3.2 Configuration of positioning tool to improve process procedures

The combination of the master arm and the slave arm has a constant home position. If the master arm of the MSM is removed from the through tube for repair, depending on the failure location, the master arm is disengaged away from the home position. Therefore, the home position of the slave is changed. To adjust this, the slave arm is taken out of the cell and decontaminated. The worker adjusts the coupling of the slave arm and brings it into the cell. After connecting the master arm, the worker connect the slave arm to the through tube. In this paper, we developed a positioning tool that can modify the coupling of the slave arm without taking the slave arm out of the cell as shown in the following figure 2. The positioning tool is replaced with a master arm, and is composed of 7 axes. When the slave arm is connected to the through tube, the three axes of the slave arm are shifted in position. The positioning tool has a lock function for 3 axes and a coupling adjustment function for 7 axes.

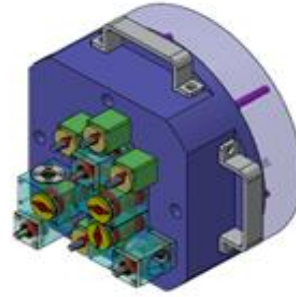


Fig. 2. Positioning tool.

3.3 Result of improvement procedure

The results of using the positioning tool are as follows. The slave arm did not move the outside and inside of the cell and did not have to change the position of the coupling and decontaminate outside the cell. This has resulted in shortening of the working time and simplification of the procedure.

4. Conclusion

This paper describes the development of a positioning tool that can save repair procedures, time and effort in master arm maintenance procedures. The failed master arm was repaired and the slave arm was taken out of the cell due to the mismatch of the coupling position of the master arm and the slave arm. Using the positioning tool working time saved at least 5 hours.

REFERENCES

- [1] Walishmiller Engineering GMBH, “Operating Manual”, 2009.