Wall-tube Flange Refurbishment for Securing Gas-tightness of Telemanipulators in the ACPF Hot-Cell

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ACPF (Advanced spent fuel Conditioning Process Facility) was constructed in the basement of the Irradiated Materials Examination Facility (IMEF) at KAERI (Korea Atomic Energy Research Institute) in 2005. ACPF, an alpha-gamma type hot-cell, was operated in an air atmosphere. This hot-cell had two cells: a maintenance cell for repairing damaged equipment or devices and a process cell for conducting experiments. In 2015, this hot-cell was refurbished to demonstrate an electrolytic reduction process of pyroprocessing in an argon atmosphere. One of the major features of the ACPF refurbishment was the construction of an additional argon cell inside the ACPF process cell with an air atmosphere. Relevant remote handling systems including telemanipulators and an argon supply system implemented to make the argon cell more functional.

The ACPF hot-cell has a configuration of 8.1 x 2.0 x 3.4 (LxWxH) m and five shielding window workstations. Each workstation is equipped with a pair of telemanipulators. Each telemanipulator consists of three modules: a master arm (installed outside the cell), a through-tube (penetrated and installed through the wall-tube), and a slave arm (installed inside the cell). The ACPF hot-cell before refurbishment was equipped with one-piece telemanipulators, in which theses three modules were connected together in one body. In an one-piece telemanipulator, these modules cannot be remotely separated in modules after being installed in the cell. Thus, when the slave arm is broken inside the cell, it is not possible to remotely replace it by a new one inside the cell without having a whole telemanipulator outside of the cell. To overcome remote replacement of the one-piece telemanipulator, three-piece telemanipulators were applied to the refurbished ACPF hot-cell in 2015. The master arm, through-tube, and slave arm of the three-piece telemanipulator are connected together through modules, and can also be separated into modules. The broken slave arm of three-piece telemanipulator, as the cell is active, can be replaced by a new one in a remote manner inside the cell without extracting the entire telemanipulator.

This technical note deals with the wall-tube flange refurbishment for replacing the one-piece telemanipulators by three-piece versions in the refurbished ACPF hot-cell. The gas tightness of the three-piece telemanipulator in the ACPF hot-cell is achieved through the contact between the wall-tube flange and the two o-rings seated in the through-tube flange. The wall-tube flange surfaces were rough and damaged after dismantling the one-piece telemanipulators from the ACPF hot-cell. The front surfaces of the wall-tube should be refurbished so that the tightness between the wall-tube flange and the through-tube flange can be secured. This refurbishment included the flange surface machining of the wall-tube such as drilling, tapping, grinding, and tightness identification in sequence. A total of ten wall-tube flanges were machined. For each wall-tube flange surface, six holes were accurately drilled and tapped at intervals of 60 degrees so that the through-tube flange of the telemanipulator can completely fit into the wall-tube flange. The flange surface was ground flat enough using specially designed tools to secure a complete gas-tightness. After completing the wall-tube flange machining, tightness tests were followed. Three-piece telemanipulators were installed through the refurbished wall-tube in the refurbished ACPF hot-cell. Currently, telemanipulators are under use by conducting various types of remote tasks in the refurbished ACPF hot-ell.