

Remote Metal Fuel Slug Fabrication System Based on Injection Casting

Kiho Kim and Jeongyong Park

Korea Atomic Energy Research Institute (KAERI), Daejeon, Korea

Corresponding author: Kiho Kim <khkim5@kaeri.re.kr>

The KAERI (Korea Atomic Energy Research Institute) has been developing a technology for fabricating TRU (Transuranium) metal fuel using TRU ingot produced from Pyroprocessing. This TRU metal fuel will be used as a fuel material of SFR (Sodium-Cooled Fast Reactor). The TRU metal fuel fabrication processes should be conducted in a fully remote manner at a hot-cell because of a nature of a high radioactivity of TRU ingot.

This paper presents an engineering-scale fabrication system for remotely manufacturing metal fuel slugs developed at KAERI. This remote fabrication system mainly consists of two sub-systems: an engineering-scale fabrication equipment and a remote fabrication mock-up. The engineering-scale equipment includes an injection casting furnace, a vacuum pump, a generator, a pressure tank, and a control panel. An injection casting furnace consists of an upper chamber, a lower chamber, a mold assembly, a mold assembly holder, a mold assembly transporter, a locking device, and a base platform. A high frequency non-cooled induction coil system was engaged inside the lower chamber of the injection casting furnace. A mold assembly can contain a maximum of 78 molds. Each mold made of quartz configures a length of 450mm, and an outer diameter of 5.70mm and an inner diameter of 8.70mm. This casting furnace was designed and constructed in modules to facilitate a remote operation and maintenance. The injection casting furnace can produce a maximum of 78 metal slugs at one operation. A remote fabrication mock-up is a facility to demonstrate an engineering-scale fabrication equipment in a remote manner. This mock-up was designed and constructed to evaluate the remote operability and maintainability of the developed fabrication equipment and test its performance fabricating metal slugs using copper or depleted uranium before TRU ingot is used. The mock-up includes tools to remotely handle the casting furnace. These tools are a pair of telemanipulators, overhead crane, and a flexible viewing window, etc. The telemanipulator (HWM, A110) has an effective handling capacity of 15 kg in any position within its workspace. A 2-ton overhead crane is mounted on tracks installed above the mock-up and provides remote handling capabilities over entire mock-up space. A single viewing window is designed to be connected with a pair of telemanipulators by a holder and can be moved in a left or right direction with respect to the front wall of the mock-up. The position of the viewing window can also be varied with the movement of the operating position of telemanipulators depending on the tasks required. Such design provides operator with a more efficient means for testing equipment located within a limited space of the mock-up.

Currently, an engineering-scale fabrication system has been established at the Fuel and Material Test Facility of KAERI. The injection casting furnace will be tested and evaluated in the remote fabrication mock-up from the remote operability and maintainability viewpoint. And then, metal fuel slug fabrication will be conducted using copper or surrogates in the middle of this year.

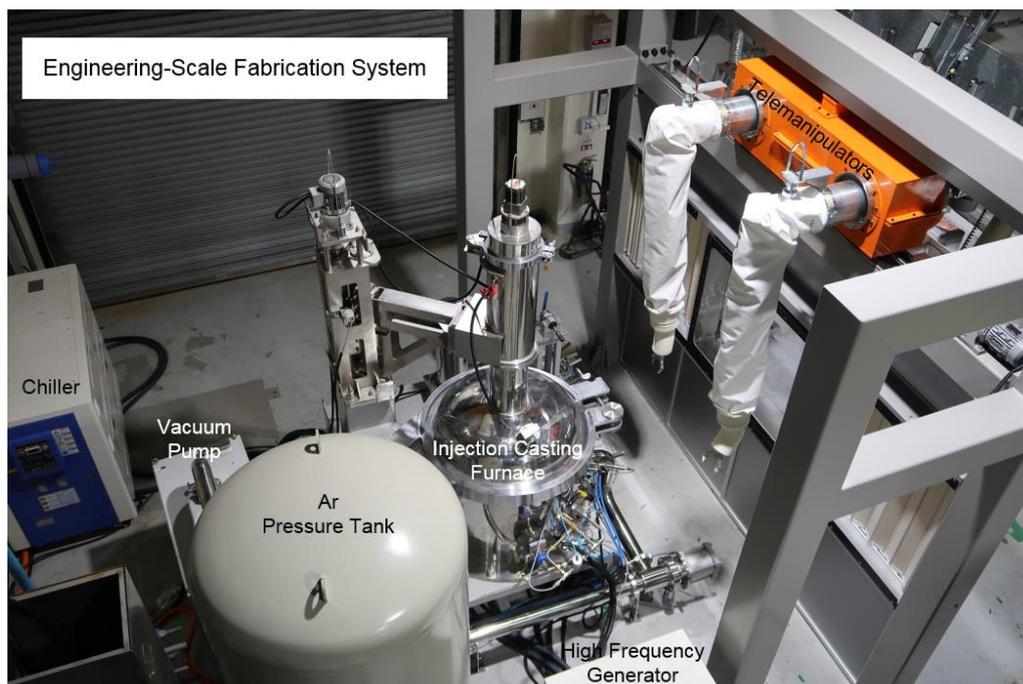


Figure P23. Engineering-Scale Fabrication System.

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