

Design and Functional Requirements of Fission Mo-99 Production Hot Cells for KJRR

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1. Introduction

The Kijang Research Reactor (KJRR), developed by the Korea Atomic Energy Research Institute (KAERI), is a specialized research reactor dedicated to radioisotope production. One of its main facilities, the Fission Mo Production Facility (FMPF), is designed to produce raw molybdenum-99 (Mo-99) solution. The FMPF consists of 18 concrete hot cells arranged in two independent production lines, with nine hot cells in each line.

The FMPF hot cells are required to provide safe and reliable environments for the handling and processing of radioactive materials. The major functional requirements include radiation shielding and remote handling, controlled material transfer and containment integrity, and effective waste management.

2. Design and Functional Requirements

The Fission Mo (FM) production process is performed inside the FMPF hot cells to produce raw Mo-99 solution from irradiated FM targets. The produced Mo-99 solution and targets for other radioisotope production are transferred to the Radioisotope Production Facility (RIPF).

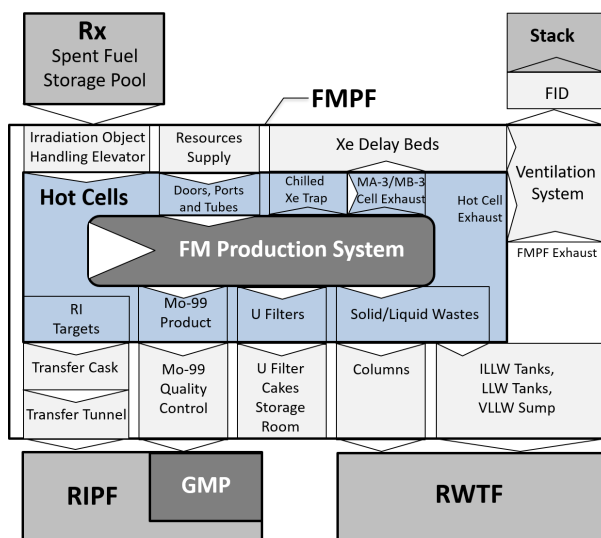


Fig. 1. Schematic of the FMPF hot cell interfaces

2.1 Shielding and Remote Handling

To meet ALARA requirements, the hot cell structures use concrete shielding walls designed to satisfy the required minimum shielding thickness. Rear doors incorporate concrete and lead shielding, while pass-thru doors, radiation shielding windows, and vertical material transfer systems (VMTS) incorporate lead shielding within the concrete shielding structures.

Manipulators and in-cell monorail hoists support remote handling, lifting, and maintenance of process equipment, targets, and internal components. Hot cell control panels allow operators to monitor and control process operations from outside the hot cells.



Fig. 2. Fabricated radiation shielding window wall liner and manipulator for the FMPF hot cells

2.2 Material Transport and Containment Integrity

To facilitate material transfer while maintaining containment integrity, the FMPF hot cells utilize VMTS, pass-thru doors, and horizontal material transfer systems (HMTS). FM targets are transferred between hot cells, while targets for other radioisotope production are transferred without processing to the RIPF using an RI transport cask. Process materials and consumables required for FM production, including columns, U-filter cups, canisters, containers, and o-rings, are introduced into the hot cells through HMTS and pass-thru doors.

For pass-thru doors connecting the hot cell interior with external areas, interlocks prevent the inner and outer doors from being opened simultaneously. The rear doors are interlocked with the RMS so that door opening is inhibited when the radiation level inside the hot cell exceeds the specified setpoint. During normal operation, the closed rear doors maintain the airtight boundary of the hot cells. The pressure differential within the hot cells is regulated by a dedicated HVAC

system to maintain the required negative pressure during operation.



Fig. 3. Fabricated rear door frame and VMTS port for the FMPF hot cells

2.3 Waste Management

Liquid wastes generated in the hot cells are classified as intermediate-level or low-level liquid wastes and collected in dedicated liquid waste tanks, respectively, before being transferred to the Radioactive Waste Treatment Facility. The waste storage hot cells are located beneath the dissolution hot cells and receive solid wastes generated during the FM production process. U-filter cups are stored in the waste storage hot cells for at least six months before being transferred to the storage vault in the U-filter cake storage room for long-term storage. Other solid wastes are transferred through the VMTS to a shielded waste handling facility, where they are sorted and placed in containers or drums for subsequent transfer to the Radioactive Waste Treatment Facility.

3. Conclusions

The FMPF hot cell design at KJRR has been established to support safe and reliable Fission Mo-99 production. The design provides the required functions for radioactive material handling, controlled material transfer, containment, and radioactive waste management during FMPF hot cell operation.

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