

Automation System for Fuel Pin Fabrication in Shielded Facility

Design, Manufacturing & Automation Group and Nuclear Fuels Group

Fabrication of $(\text{Th-}^{233}\text{U})\text{O}_2$ fuel pin for Advance Heavy Water Reactor (AHWR) is a challenging task because of ^{232}U contamination in fuel that results in high gamma activity. This requires entire operations of this fuel fabrication to be performed remotely in shielded cells. Also, long length (≈ 3.8 m) of pin combined with its small diameter (≈ 11.2 mm) and presence of spacer pads make the automated pin handling difficult. In order to demonstrate automated fabrication, inspection and handling of such fuel pin, a first of its kind, full scale mock-up facility (Fig 1) has been recently developed and commissioned in BARC.

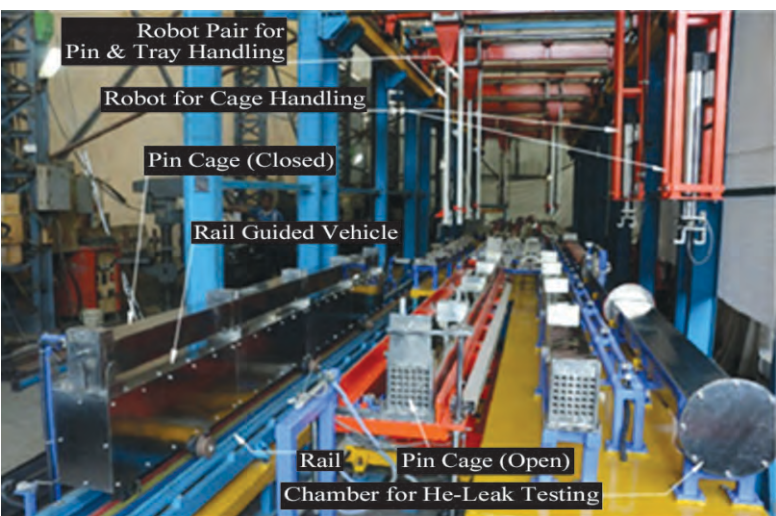


Fig 1: Full Scale Mock-up Facility

The facility consists of a series of inter-connected cells. Fuel clad tubes welded with bottom end plug and spacer pads are brought to the facility in a cage and accepted pins are taken out of the facility in another cage, after pellet insertion, processing and inspection. During the pin fabrication, end plugs are welded and a thorough automated inspection is carried out for high quality assurances. The major operations performed on the clad tube or fuel pin are insertion of pellets into the tube, top end plug welding, buffing the welded area, various dimensional measurements, weight checking, visual inspection, X-ray radiography of weld area, Helium leak detection and gamma scanning. In addition, it involves

handling material among various equipments in various stations. In order to meet the unique requirements for inter cell material movement; a Rail Guided Vehicle (RGV) has been developed. Further, intra cell material movement is carried out by a pair of specially designed robotic arms. Pin, pin tray and pin cage as shown in fig 2 are also developed for demonstration of the system operation. A few conventional techniques have also been modified and mechanisms have been developed for automated fuel pin inspection.



Fig 2: Pin, Pin Tray & Pin Cage

All operations are controlled automatically and remotely monitored. Operator can intervene and control the system in semi-automated or manual modes. Inspection results of all pins are logged and are available for analysis. The online status of all stations is available at control station on a SCADA screen. Images from CCTV cameras are monitored continuously to monitor the safe operation. System reliable operation in the given space constraints has been the real challenge in system design.