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RECENT PROGRESS ON THE MIT RESEARCH REACTOR (MITR) CONVERSION FROM HIGHLY ENRICHED URANIUM TO LOW ENRICHED URANIUM FUEL

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ABSTRACT

The Massachusetts Institute of Technology Reactor (MITR) is a 6 MW research reactor operating with highly-enriched uranium (HEU) finned plate-type fuel. It delivers a neutron flux comparable to light water reactors in the compact core, and has demonstrated track record in performing advanced materials, fuel, and instrumentation irradiation tests in light water reactors or high temperature reactors conditions. The conversion objective is to design a low-enriched uranium (LEU) fuel element that could safely replace the current 15-plate HEU fuel element and maintain performance while requiring minimal changes to the reactor structures and systems. The selected monolithic U-10Mo LEU fuel design is a 19-plate unfinned fuel element with three different fuel foil thicknesses, denoted as “FYT” element design. The LEU fuel design has been shown to deliver 7 MW safely to maintain the neutron flux performance of the 6 MW HEU core. The preliminary safety analysis report (PSAR) has been submitted to the U.S. NRC. A transition core plan, from 22 fresh LEU elements gradually to 24 elements equilibrium core configuration, has been demonstrated. The transition core plan evaluated a fixed pattern refueling scheme, where three fresh LEU fuel elements and three end-of-life elements are regularly introduced and discharged after each 10-week power cycle. Results show that an equilibrium core is achieved after seven fuel cycles. Neutronic and thermal hydraulic modeling results demonstrate an adequate margin below the proposed fission density limits and a significant safety margin to onset of nucleate boiling for all transition and equilibrium cores. All other core parameters can be maintained within the safety envelope as well. Engineering drawings of LEU fuel elements have been completed as an initial step to develop fuel specifications. Future work for the MITR conversion study includes the evaluation of fabrication tolerances and an LEU core startup plan.