Public Abstract

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Title:THERMAL-HYDRAULIC OPTIMIZATION FOR HIGH PRODUCTION OF LOW-ENRICHED URANIUM BASED MOLYBDENUM-99

Globally, more than 20 million samples of technetium-99m are used annually to diagnose many different forms of cancer. Despite this, there are only four main nuclear reactors worldwide that produce molybdenum-99, the parent isotope of technetium-99m. In an attempt to address the growing demand, as well as to motivate the current reactors to stop using high-enriched uranium, the University of Missouri Research Reactor (MURR) has begun to produce molybdenum-99 using low-enriched uranium. The fission of uranium-235, for which one of the products is molybdenum-99, generates approximately 2 kW of heat per 4-gram target. Continually removing this heat from the fission reaction is the limiting factor in the high-volume production process. The objective of this thesis is to find a reactor wedge setup with maximum rate of heat removal, thereby maximizing the amount of molybdenum-99 that can be created in the reactor.To maximize heat transfer, a quasi 1-D analytic model, calibrated numerically, is created to hydraulically and thermally model the coolant flow through the current reactor setup. Using flow network modeling (FNM), this analytic model is expanded to analyze other potential geometries. Features of these geometries are then examined parametrically to determine the maximum rate of heat transfer from the area available in a single reactor wedge.