Public Abstract

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Title:THERMAL-MECHANICAL ANALYSIS OF TARGETS FOR HIGH VOLUME PRODUCTION OF MOLYBDENUM-99 USING LOW-ENRICHED URANIUM

Techenetium-99m is diagnostic radioactive medical isotope that is currently used 30,000 times a day in the United States. All supplies of techenetium-99mâ€™s parent isotope molybdenum-99 currently originate from nuclear reactor facilities located in foreign countries and use highly enriched uranium (HEU).
Current molybdenum-99 production uses HEU in a powder dispersion target. The powder dispersion method, conventionally used for fuel rods and plates, combines fine particles of aluminum and HEU that are bonded into a rigid plate during irradiation. In accordance with the Global Threat Reduction Initiative all uranium used in future molybdenum-99 production will use low enriched uranium (LEU). Unfortunately LEU has a much low fissionable density then HEU which makes the dispersion process economically unviable. A design approach to increase the LEU density is to use a target that is based on LEU foil. The foil design places a LEU foil between either two concentric annular aluminum cylinders or two aluminum plates which are pressed and welded together to produce a structure that allows for easy removal and processing. The drawback of these designs is the thermal contact resistance between the LEU and aluminum cladding during irradiative heating is very sensitive to the target design, manufacture, and irradiation holder. This thesis explores those thermal-mechanical design issues for both the cylindrical target design and the plate target design. Analytical, numerical and experimental studies are used to assess the mechanical deformation for these structures and its effect on the targetâ€™s thermal contact resistance.