Public Abstract

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Title:THERMAL MECHANICAL ANALYSIS OF A LOW ENRICHED URANIUM FOIL BASED ANNULAR TARGET FOR THE PRODUCTION OF MOLYBDENUM 99

One goal of the global threat reduction initiative by the US department of Energy is to eliminate the use of high-enriched uranium from the production of the radio-isotope Molybdenum-99. One strategy to achieve this goal is to use a target that utilizes a low-enriched uranium (LEU) foil. This thesis considers an annular target, where an LEU foil of open cross section is sandwiched between two concentric aluminum tubes. A recess is cut on the inner tube to hold the LEU foil and facilitate assembly. The target must contain the fission products until it can be opened and the LEU foil removed for further processing. The thermal contact resistance between the LEU foil and the aluminum tube cladding needs to be low enough to ensure that the LEU temperature doesnâ€™t exceed the operating temperature specified by the reactor safety case.

The commercial finite element code Abaqus was used to perform a fully coupled thermal stress analysis on the annular target with a recess to analyze the conditions under which the target could potentially fail. A parallel numerical model for an annular target with uniform heating was developed in Abaqus and an analytic model to predict the thermal stresses in a composite structure was derived. This analytic model, along with existing analytic models was used to validate the uniform heating numerical model. The uniform heating model was then used to validate the annular target with a recess. It is found that the magnitude of separation between the foil and the tubes can be controlled by controlling the ratio of heat transfer coefficients between the inner and the outer tube. Also, based on the thickness ratio studies, it is found that the current annular target design is safe at high heat fluxes.