Public Abstract
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Graduation Term:FS 2014
Department:Mechanical & Aerospace Engineering
Degree:PhD
Title:THERMAL MECHANICAL ANALYSIS OF APPLICATIONS WITH INTERNAL HEAT GENERATION

The radioactive tracer Technetium-99m is widely used in medical imaging and is derived from its parent isotope Molybedenum-99 (Mo-99) by radioactive decay. The majority of Mo-99 produced internationally is extracted from high-enriched uranium (HEU) dispersion targets that have been irradiated. To alleviate proliferation risks associated with HEU-based targets, the use of low-enriched uranium (LEU) sources is being mandated. However, the conversion of HEU to LEU based dispersion targets affects the Mo-99 available for chemical extraction. A possible approach to increase the uranium density, to recover the loss in Mo-99 production-per-target, is to use an LEU metal foil placed within an aluminum cladding to form a composite structure. The target can be deemed structurally safe as long as the thermally induced stresses are within the yield strength of the cladding and welds. As with the thermal and structural safety of the annular target, the thermally induced deflection of the BORAL®-based control blades, used by the University of Missouri Research Reactor (MURR®), during reactor operation has been analyzed. A finite element model is solved as a fully coupled thermal mechanical problem as in the case of the annular target and the resulting deflection is compared with the channel gap to determine if there is a significant risk of the control blade binding during reactor operation. The common theme in both these applications is the nuclear heat source, high heat flux, non-uniform heating, composite structures and differential thermal expansion. The goal is to establish the target and component operational safety.