

ANALYTICAL MEASUREMENTS AND PROTOCOLS FOR THE QUALIFICATION OF NpO₂ TARGETS FOR IRRADIATION IN ORNL'S HIGH FLUX ISOTOPE REACTOR*

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The Oak Ridge National Laboratory is currently conducting a technology demonstration for the production of Pu-238 through the irradiation of aluminum doped NpO₂ pellets in its High Flux Isotope Reactor (HFIR), with the goal of producing 1.5-2 kg of Pu-238 per year for NASA space programs. The Nuclear Analytical Chemistry and Isotopics Laboratories (NACIL) Group leads the analytical effort for this project which includes providing the experimental radiological data required for the qualification of the NpO₂ targets with the goal of maximizing production of Pu-238 for each irradiated target batch. For this work a number of analytical protocols are being used to understand to an exacting degree the number of activation and fission events occurring within a given pellet during irradiation at target positions within the HFIR. Presented will be a history of past analytical data which indicate large uncertainty in prediction of fission rates within a target which have been attributed to uncertainties in the neutron transmutation cross sections and fission product yields of Np-238. Also, presented will be the analytical protocols and measurements which are being used to quantify fission events in neptunium wires irradiated at the group's Neutron Activation Analysis (NAA) facility to gain better insight into activation and fission using a very well established neutron flux. The analytical methodologies discussed will include high precision isotope dilution inductively coupled plasma mass spectrometry (ID-ICPMS) coupled with high pressure liquid chromatographic separations, gamma spectroscopy for very short lived fission products, and comprehensive accountancy by mass for low and high mass fission products produced in the activated wires by combining measurements made using gamma spectroscopy and ICPMS.

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