DEVELOPMENT OF MURR FLUX TRAP MODEL FOR SIMULATION AND PREDICTION OF SAMPLE LOADING REACTIVITY WORTH AND ISOTOPE PRODUCTION

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ABSTRACT

University of Missouri Research Reactor (MURR) is the highest power university research reactor in America. It has been supplying various radioisotopes for more than 20 years. The flux trap, locating in the center island tube, has the highest flux for sample irradiating with an ability of $6x10^{14}$ n/cm^2/s. It is very important for the MURR to be able to predict the reactivity worth of sample loading in the flux trap, as well as the production of specific isotopes.

The research develops MURR Flux Trap Model (MFTM) which simulates the reactor core and flux trap area, solves the neutron transport equation and calculates the loading worth based on the Monte Carol method, proceeds with burnup and decay calculation, and predicts the requested isotope production. MCNP part of the MFTM model carries out neutron transport calculations and predicts the reactivity worth of sample loading in the flux trap while MonteBurns part of the model calculates isotope production from the target sample irradiated in the flux trap by solving the general nuclide depletion equation. Different sample loadings and their measurement data have been provided by the MURR for benchmarking the model during the developing period. The discrepancy between the model and the corresponding experimental data has been analyzed. Over-prediction of the negative worth of KCl samples was determined to be the cause of most of the deviation between the model and experimentally measured results. The original MCNP model has been refined with the consideration of the self-shielding effect and burnup effect. The modified model has yielded better predictions approaching the experimental values. The MCNP and MonteBurns models were integrated into an automatic analytic tool with Visual Basic language for efficient usage by the MURR. The automated package has been successfully run on the MURR MCNP Server.