A simulation package is being developed to aid in the characterization and identification of unique nuclear material signatures throughout the nuclear fuel cycle. This work is focused on predicting a prompt-gamma sample response to epithermal-neutron activation analysis (ENAA), which will be performed using the mechanical chopper system designed for the Pennsylvania State Breazeale Reactor. The chopper system will allow for the energy selection of epithermal neutrons for ENAA and will allow for isotopic material analysis with greater sensitivity compared to thermal neutrons. This project directly supports Thrust Area 2: Signals and Source Terms for Nuclear Nonproliferation. Correlating the prompt-gamma response with the delayed gamma signal will complement the non-destructive analysis capabilities afforded by ENAA. Ultimately, the goal of this work is to assess both prompt- and delayed-gamma responses from an unknown sample and compare them with known gamma responses throughout the nuclear fuel cycle. Because significantly less prompt-gamma data are available versus delayed-gamma data, the simulation package uses DICEBOX to generate expected prompt-gamma responses. DICEBOX is an open-source Monte-Carlo code, which simulates gamma cascades from a nucleus using statistical models of level density and photon strength functions. Once a reference library of gamma responses has been constructed, the simulation package may be expanded to allow for the use of machine-learning techniques to aid the user in identification of any unknown sample which may undergo ENAA. Inferences may then be made about the sample's processing history or its provenance for nuclear forensic characterization.