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Development and inital testing of a camera-based neutron imaging system in an epithermal neutron beam with high gamma radiation content

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The Neutron Radiography Reactor (NRAD) at Idaho National Laboratory (INL) provides neutron imaging capabilities for evaluation of highly-radioactive objects. Neutron radiographs are currently acquired using the transfer method with converter foils and x-ray film. While this process produces high-quality neutron radiographs with a large field of view, it is expensive and time consuming. Furthermore, the time and expense of the current process preclude performing neutron tomography as a routine examination technique. If neutron tomography is to be realized as a routine technique, modern digital neutron imaging systems must be developed that can operate in high radiation environments and for highly-radioactive specimens. Towards this goal, INL has begun developing camera-scintillator based neutron imaging systems. A first-generation system was built in collaboration with colleagues from FRM-II and tested in the NRAD's East Radiography Station (ERS) at INL. Useful neutron radiographs of non-radioactive test objects were acquired despite image noise and disruptions with system electronics caused by the high gamma dose rate in the ERS neutron beam of >2 Sv/hr. Subsequent efforts acquired a series of images of a surrogate fuel specimen at various angles that revealed an internal crack that is not distinguishable in a single radiograph, thus demonstrating the utility and potential benefits of neutron tomography for such applications. The lessons learned from these initial efforts informed design of a second system that is currently being built. This presentation will describe the activities thus far, imaging system design and approach, and plans for future activities.

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