## ABSTRACT

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# Neutron Imaging For NMC&A

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In 1998, Oak Ridge National Laboratory (ORNL) used active neutron and gamma-ray interrogation with a time-tagged $^{252}Cf$ spontaneous fission source to successfully measure the holdup in a large 24-in.-diam pipe at the K-29 Building of the former Oak Ridge Gaseous Diffusion Plant. In calendar years 2005 and 2006, ORNL performed for various U.S. Department of Energy groups and the Defense Threat Reduction Agency five different neutron imaging demonstrations at the Y-12 National Security Complex (Y-12 Plant). These demonstrations utilized a portable neutron radiography system that can identify nuclear weapons and components as being gun assembled, compression fission, or thermonuclear. Since that time, improvements in the DT generator and the alpha particle detection have reduced the measurement time considerably. This system has application for nuclear material control and accountability (NMC&A)—such as fissile materials transfer, both external and internal, between facilities. For certain types of materials in an international inspection, the system would be used with an information barrier. If the shape and composition of the materials are known by the receiver, the measured images can be compared with existing data and, thus, the detailed shape of container contents verified without opening the container. This system can provide images on, for example, storage cans of highly enriched uranium for which the material is known but the configuration may not be known. The system can be used in the template-matching or attribute-determination modes. Other applications include mass determinations in process equipment that would otherwise have to be emptied to determine the fissile mass, an effort that would be costly and represent a safety concern. The neutron imaging utilizes transmission of the 14-MeV neutrons compared with an initial measurement in air without the container and material between the neutron source and the detectors. For fissile material determinations, the induced fission radiation emitted after the transmitted neutron peak is analyzed. This paper discusses NMC&A applications and the current status of the system.