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Pulsed Fast Neutron Analysis - A Nuclear Technique for Screening Air Cargo -

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ABSTRACT. A powerful tool for air cargo inspection exists at the George Bush Intercontinental Airport in Houston, Texas USA that utilizes the Pulsed Fast Neutron Analysis (PFNA) technique. Funded by the Transportation Safety Administration under the United States Department of Homeland Security, a system has been developed to detect explosives at the threat level in a wide range of cargoes. The system utilizes a tandem Van de Graaff accelerator operating at a frequency of 3.5 MHz that produces pulses of deuterons with a Full Width at Half Maximum of 1.5 ns in duration. Neutrons of several nanosecond duration are created through the d,D reaction at an energy of around 8 MeV at a deuteron beam current of up to 140 micro-A. A neutron collimator near the deuteron gas target produces a neutron beam spot 9-cm wide by variable (typical) 12-cm tall at the center of the container. This neutron beam oscillates vertically by moving the collimator. Translational motion of the air cargo is provided by a constant-velocity conveyor system. The inspection volume is surrounded by a large array of 14-cm cube NaI detectors to collect the gamma-rays from the neutron inelastic scattering reactions occurring within the volume. Using a time-of-flight technique to determine the position in the container in which the neutron inelastic scattering reactions occur, the data acquisition system and the image reconstruction engine produce a three dimensional image of the cargo contents. The images have a typical volume element granularity of 6.3 cm wide x 6.3 cm wide x 8 cm deep. This technology employs personnel from a variety of engineering disciplines. Electrical engineers designed the particle accelerator. Mechanical engineers designed the cargo conveyance system. Chemical engineers fabricated the explosive threat simulants. Nuclear engineers studied nuclear cross sections, gamma-ray signatures, and radiation detectors. Computer engineers designed control and user interface software. Examples of their work will be presented in the context of the PFNA technology.

BIOGRAPHY. Dr. Strellis is the Director of Technical R&D Programs at Rapiscan Laboratories in Sunnyvale, CA. Rap Labs is the Research and Development entity for Rapiscan Systems, a worldwide supplier of security screening systems utilizing x-ray, gamma-ray, and neutron based inspection systems. In his role, Dr. Strellis is interested in forming collaborations with academia and national laboratories to study the fundamental science behind technologies that could enhance security screening systems in the future. He has served as the primary investigator on a variety of cargo screening developmental program funded by the Department of Homeland Security, the Domestic Nuclear Detection Office, the Department of Defense, and the Transportation Security Administration. Before joining Rapiscan, he did his Ph.D. dissertation work at the Lawrence Berkeley National Laboratory at the 88-inch Cyclotron. There he studied the fission properties of heavy elements utilizing fast chemistry separation techniques and novel detection systems. Along with an international collaboration, he was part of the research team that performed the first successful chemistry experiments on Bohrium (element 107).