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DEVELOPMENT OF A TRACE EXPLOSIVES DETECTION PORTAL FOR PERSONNEL SCREENING

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ABSTRACT

We discuss the development, design, and operation of a walk-through trace detection portal designed to screen personnel for explosives. Developed at Sandia National Laboratories (SNL) with primary funding from the Federal Aviation Administration (FAA) and additional support from the Department of Energy Office of Safeguards and Security, this portal is intended primarily for use in airport terminals and in other localities where a very high throughput of pedestrian traffic is combined with stringent security requirements. The portal is capable of detecting both vapor and particulate contamination, with the collection of explosive material being based upon the entrainment of that material in air flows over the body of the person being screened. This portal is capable of detecting most types of common high explosives of interest to the FAA. We discuss the results of field testing of the portal in the Albuquerque International Airport in September, 1997 and more recent steps towards commercialization of the portal.

INTRODUCTION AND PORTAL CONCEPT

There is currently no ideally suited technology for rapidly screening large numbers of people for explosives. Commercial trace detection systems utilize swipe collection, which

can be highly effective but is too time consuming (> 30 seconds/person screened) and possibly too invasive for widespread public acceptance. Trained canines are also very effective, but dogs are generally not used for personnel screening because of the chance that a dog will bite someone, public fear of dogs, and the inability of dogs to work continuously for long time periods. Low-dose backscatter x-ray systems that look under clothing present serious privacy concerns and also suffer from the perception that the radiation used may be harmful to humans, although the radiation dose is much less than that received in a typical trip on an airplane. Other promising technologies, such as millimeter wave portals and quadrupole resonance, have not yet advanced to the point where reliable commercial systems for personnel screening are available. Physical search is far too slow and invasive for all but a handful of applications. Since none of these technologies currently fulfill the desired requirements, there is a need to develop trace detection portals that combine high sensitivity with the ability to accommodate high throughput rates. For widespread deployment in airports, such systems need to approach the throughput rate typical of current walk-through metal detectors: about six seconds per person, or 10 persons per minute.

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The present portal was developed with the intent of producing a prototype system that could meet the requirements for airport screening of personnel. A schematic representation of the portal is shown in Figure 1.

Explosives Detection Portal

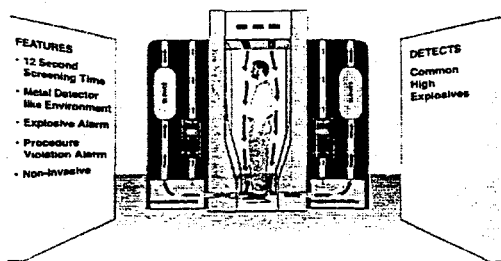


Figure 1

Collection of explosive material is based entirely on air flows; there is no physical contact with the screened individual. A gentle airflow, not unlike the air curtain one feels when entering a supermarket, flows down from the top of the portal to the feet, entraining any explosives vapor and/or dislodged particles from the subject's clothing. Horizontal air nozzles between the knees and chest also emit puffs of air that aid in particle dislodgement. Once the main airflow reaches the feet, it is drawn into a filtering device known as a preconcentrator, with approximately 160 liters/second being drawn into each of the two preconcentrators, one on each side of the portal. The preconcentrator, based on a proprietary SNL design, allows air to pass through to an exhaust line, while heavy organic molecules such as explosives are collected on an adsorbing surface. After approximately four seconds during which air from the portal flows into the preconcentrator, the air flow from the portal is shut off, the adsorbing surface in the preconcentrator is heated, and an air flow of approximately 4 liters/minute directs any adsorbed explosive material into a

commercial detector known as an ion mobility spectrometer (IMS). The entire screening process, including the entrance of the subject into the portal, exiting the portal, and determination by the system software as to whether or not any explosive material was detected, takes about 12 seconds.

AIRPORT TESTING AND PORTAL COMMERCIALIZATION

After extensive laboratory testing at SNL, the portal was field tested at the Albuquerque International Airport for two weeks in September, 1997. Over 2400 volunteers passed through the portal during this time period. Since only volunteers were used in this field test, it could be safely assumed that no person actually carrying a bomb went through the portal. However, this testing allowed us to make a number of observations and conclusions concerning public acceptance of this type of screening, throughput rate, false alarms, and nuisance alarms. Among the more important results were the following:

- (1) Depending upon how the appropriate questions were phrased, the portal received an approval rating of 97-99 %, i.e. > 97 % of the screened people had no objections to the portal based on invasiveness or any other cause, and thought that the portal should be deployed in airports if proven effective in detecting explosives.
- (2) The throughput rate was verified to be just under 12 seconds per person screened, or about 5 people per minute.
- (3) Approximately 20 presumed false alarms were recorded during the test period, indicating a false alarm rate

of slightly less than 1 %. Most of these alarms were weak, and it is possible that some were really nuisance alarms due to the presence of real explosive contamination of the persons involved.

- (4) A definite detection of explosive material was made on one volunteer, who turned out to be a worker from the nuclear weapons complex. Several days earlier, this individual had been to a site where explosives are frequently handled, without having handled explosives himself. He was wearing some of the same clothing that he had worn to the site in question, and was thus

contaminated enough to produce clear alarms on three out of four passes through the portal.

Since SNL does not market or mass-produce any products, our current efforts are focussed largely on finding a commercial company that is willing to market this portal. A Commerce Business Daily ad placed early in 1998 resulted in considerable interest, and an on-going selection process currently involves eight companies. It is expected that a company will be selected sometime in August, 1998, and commercial availability should commence shortly thereafter.

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