FAA's Bomb Scanner: An Awkward Goliath?

The U.S. response to the Lockerbie bombing is an impressive bag checker, but one that will not "see" little bombs

THE FAMILIES OF THOSE WHO DIED last December on Pan Am flight 103 over Scotland lobbied President Bush and Congress this year to act quickly to combat luggage bombs. They got a 10-ton response. A massive, complex, million-dollar nuclear scanner has been installed at JFK Airport in New York. At the same time, the Federal Aviation Administration (FAA) is rushing five more into production and possibly will ask U.S. airline companies to install 400 of them at 40 key airports around the world by 1999. If the proposal stands, the airline industry estimates it will have to put 30 to 50 machines at JFK Airport alone. The construction job will be enormous.

Bad news for terrorists? Perhaps, but in recent weeks, as the limitations of the scanner have become clear, its promise has faded. Because it was designed to spot bombs containing 2.5 pounds of explosive, it is unlikely to have spotted the bomb on flight 103, which British experts believe contained only 1 pound of plastic. Although the manufacturer hopes to upgrade the scanner to catch very small bombs, it is not yet clear that retro-engineering will succeed.

The new detector, called a thermal neutron analysis (TNA) device, uses neutrons emitted by Californium-252 to probe luggage on a conveyor belt. It reads signals from the test object, searching for the distinctive (10.8 MeV) gamma rays from nitrogen present in commercial and military explosives. Manufactured by Science Applications International Corporation of Santa Clara, California, the TNA system has been called America's best answer to airplane terrorism (*Science*, 13 January, p. 165).

TNA recently got a boost from Congress, which passed a law on 30 June telling the FAA it should begin this fall to deploy "explosive detection equipment that meets minimum performance standards . . . equivalent to or better than thermal neutron analysis." However, in the light of new information on mini-bombs, these instructions now seem overbearing. One member of Congress, Representative Cardiss Collins (D–IL), chair of the House Government Operations subcommittee that oversees the FAA, thinks this and other systems should be tested before any is locked into place. She plans hearings on 25 and 26 September.

Britain's Royal Armaments R&D Establishment has concluded, based on similarities to a bomb found in a Toshiba radio seized by German police last year, that the Pan Am 103 bomb may have contained less than 150 grams of nitrogen. This is less than half the level the TNA machine is designed to spot in routine operation. Collins concludes: "The FAA is proposing that enormous expenditures be made by the airlines for a technology that may not protect the public and the industry from the explosives that have caused the most devastating damage."

Tsahi Gozani, the Israeli- and Swiss-educated physicist who designed the TNA system for Science Applications, brushes aside such skepticism. He suggests the size of the Pan Am 103 bomb has been understated, claiming, "There is a lot of debate" about its actual dimensions. He speculates that the Toshiba radio bomb found in Germany was just a "trigger" for a larger device.

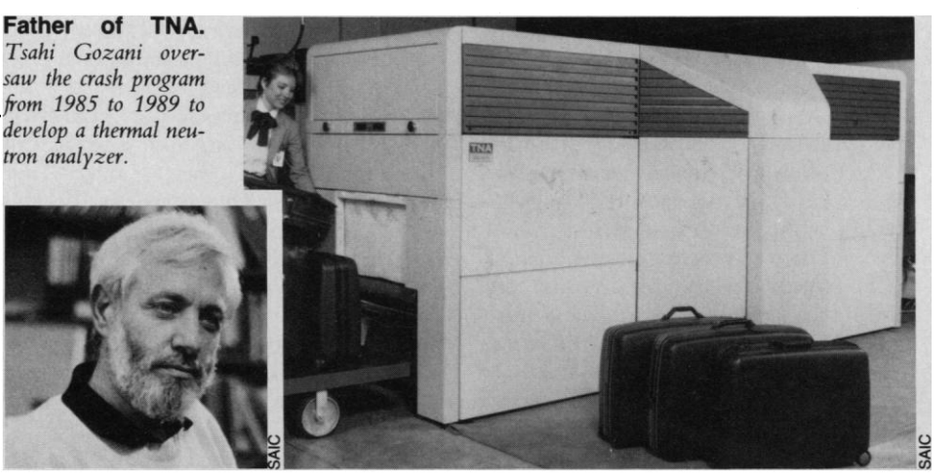
There is no evidence for this, says Edith Holleman of Representative Collins' staff. She has found other instances in which small bombs have done severe damage, including a blast involving less than a pound of explosives on a Pan Am flight to Hawaii in August 1982 that killed one passenger and injured 15 others, and a similar bomb in April 1986 that blew a hole in a TWA plane, ejecting four passengers.

Another bit of information favors the small-bomb hypothesis, says Martin Annis, president of American Science and Engineering, Inc., a company that makes x-ray screening devices. According to Annis, Israeli investigators believe that small bombs may have a disproportionate effect on jumbo jets which contain a huge volume of pressurized air. The stored energy is released violently if a bomb ruptures the skin, adding 1 to 2 pounds of force.

If mini-bombs do pose a significant threat, Gozani says, his TNA device can be adjusted to look for them. The catch is that tuning up its sensitivity sends the number of false alarms upward. The problem is that wool, nylon, leather, plastic ski boots, and some foods have nitrogen densities as high as plastic explosives. If heavy trunks and woolen clothing are involved, it becomes hard to distinguish a real bomb from background readings, creating false alarms.

As a rule of thumb, a false alarm rate of 5% represents 30 uncleared bags on one jumbo jet flight. The airlines cannot cope with such large requirements for hand-searching luggage, and they want to reduce the TNA machine's alarm rate from 4% to 1%. The rate they would face if the TNA machine were adjusted to scan routinely for 1-pound bombs would be unacceptably high, and thus the machine would almost never be used this way.

Gozani has already had some experience with this problem. He says the TNA machine now at Kennedy Airport was tested for its ability to spot a simulated Toshiba radio bomb. In nine out of nine attempts, it succeeded in a test run. However, when it was asked to perform in a private demonstration, it failed two out of three times. He reads this as a 10-in-12 success rate; others see it as a failure. Anyway, says Gozani, "if our system forces the terrorist to use smaller and smaller explosives, the damage that he can cause is smaller and smaller," and that is good.



Father of TNA. *Tsahi Gozani oversaw the crash program from 1985 to 1989 to develop a thermal neutron analyzer.*

But TNA may have other drawbacks. In addition to its mini-bomb problem, it has trouble seeing "sheet explosives"—thinly rolled plastic material that can be incorporated into suitcase panels or molded into objects inside the suitcase. Nor does TNA detect non-nitrogenous bombs. Finally, TNA is considered impractical for screening carry-on bags at this time, partly because its detector uses ionizing radiation. It is best not to have passengers near the machine when it is running. Gozani says the company is developing a new model that could be used for carry-on luggage.

Pointing to these limitations, several municipal airports, the Air Line Pilots Association, and others have written to the FAA saying it would be unwise to go full bore into deploying TNA machines just now. It would be "totally premature" to mandate broad use of TNA, writes Richard Lally, vice president for security at the Air Transport Association. By rushing ahead, Lally claims, the government could freeze out other more efficient techniques.

Likewise, Representative Collins is concerned that spending tens or hundreds of millions of dollars on TNA in the next decade "could have the unfortunate result of locking the industry into the wrong technology, providing a false sense of security to the flying public and aborting other technologies now under development that have the potential of providing much more complete detection of plastic explosives." She sees three new types as the "most promising" for the future: those based on fast neutrons, kinetically focused neutrons, and nuclear resonance absorption.

According to Lee Grodzins of the Massachusetts Institute of Technology (MIT), an FAA consultant, the tests using both the nuclear resonance absorption and fast neutron technologies "have all been very positive." He thinks there is "no question" but that the TNA machine would be impractical as a scanner for 1-pound bombs, saying "it was never developed" for that purpose.

MIT's Grodzins is enthusiastic about the effort to use nuclear resonance absorption, which he believes may be only a few years away from delivering a prototype. Israel, which is investigating the technology at its national laboratory at Soreq, leads the research in this field. One major advantage over TNA is that it appears to be able to detect not just nitrogen, but other key elements such as oxygen and perhaps carbon, with great accuracy. This would provide the machine's computer two or three variables to use in pinpointing chemical constituents, virtually guaranteeing that explosives would be spotted, even in small quantities. "It would allow us to discard a tremendous number of false positive signals," Grodzins says, reducing the error rate from 2 to 4 per 100 to perhaps 1 per 1000. Nuclear resonance machines have another advantage: they do not require radioactive isotopes.

While he finds this research exciting, Gozani says it would be a mistake to postpone deployment of TNA, the best available technology, in the hope of getting something better. "That is a silly argument," he says. "Based on that, you would not have built cars." The sensible approach, and the one the FAA is following, according to Gozani, is to buy the best now and invest in R&D for a better machine later.

Grodzins agrees with this strategy, as do several other researchers in the field. Grodzins says the FAA has decided to "ride both horses" at once—buying TNA machines for the early 1990s and pumping additional funds into a second-generation system for the next century. But these researchers wonder whether a massive investment in hundreds of TNA machines in the 1990s would stimulate or smother interest in the alternatives. ■ ELIOT MARSHALL

NSF's Summer of Discontent

The call has gone out from the friends of the National Science Foundation: Circle the wagons. The NSF budget for 1990—already cut by the House of Representatives below the Bush Administration's requested level—is facing further attacks in the Senate. NSF's allies have been trying to use the August congressional recess to launch a lobbying counterattack, but with most Washingtonians out of town, it's proved difficult to find someone to lobby.

Although NSF's budget has grown steadily in recent years, Congress has never gone along with the rate of growth sought by the White House. The largest, and most vulnerable, part of the NSF budget goes for research and related activities. The House of Representatives' version of NSF's appropriation bill puts the research account at $1.715 billion, 8.3% above the 1989 budget, but $88 million below the Bush Administration's request. The Senate appropriations subcommittee is likely to peck away at that amount when it takes up the appropriations bill after the Senate reconvenes in September following the summer recess.

NSF is in direct competition with several other federal agencies for support. The Veterans Administration, the Department of Housing and Urban Development, the National Aeronautics and Space Administration, and the Environmental Protection Agency are all included in the same appropriation bill and have to fight over the same, fixed amount of money. To make matters worse, because of different revenue estimates, the Senate must cut some $500 million from the bill passed by the House.

So science lobby groups are sounding the call to arms. The Coalition for National Science Funding sent out a memo to its members on 16 August warning them that "perceived silence from those who support NSF research and education programs could be interpreted by senators and appropriations staff as suggestive of a capacity to absorb further cuts." The memo adds that "Congressional staff tell us pointedly that the House-passed bill could well be the high water mark for NSF. The total bill could be cut by an additional 2 to 4% before final passage."

The focus of the lobbying is Senator Barbara Mikulski (D–MD). This will be her first year as chairman of the appropriations subcommittee, and no one is certain how sympathetic she'll be to requests for science funding. But Robert Park of the American Physical Society's Washington office says initial meetings have not been encouraging. "[I] have not come away feeling that she had any real understanding of what the NSF was for. I don't think she has a notion of where it fits into the picture." A spokeswoman in Mikulski's office said the senator did understand NSF. But like much of official Washington she is out of town and could not be reached for comment.

Park says Congress has got some misguided attitudes about NSF. "There's a widespread perception among staff members on the Hill that science has done extremely well, and that NSF in particular is fairly awash in money," he says. "If you ask how is the individual scientist supported by NSF doing, the answer is disaster. [Congressional staff] are looking at the wrong numbers and asking the wrong questions. I don't know how to turn that around, but I think we're in for a grim year."

Jerold Roschwalb of the National Association of State Universities and Land Grant Colleges is also gloomy about NSF's prospects: "Everyone I talk to whose judgment I value tells me that we should be celebrating this year because next year's going to be worse." ■ JOSEPH PALCA