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COLUMN ONE

## In the lab, cooking up bomb detectors

**At the Transportation Security Laboratory, chemists, physicists and engineers dream up ways a weapon might be slipped onto a plane, then figure out how to stop it. It's part science, part James Bond.**

By Bob Drogin

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Reporting from Atlantic City, N.J.

Eight years after the Sept. 11 attacks, the front line in America's war on terrorism runs through a little-known federal laboratory where engineer Nelson Carey holds what appears to be a bratwurst in a bun.

"This is a Semtex sausage," said Carey, as he pinched the pink plastic explosive long favored by terrorist groups.

On his table lies a green Teletubby doll stuffed with C-4 military explosives, a leather sandal with a high-explosive shoe insert, an Entenmann's cake covered in an explosive compound that looks like white frosting, and other deadly devices Carey and his colleagues have built. None have detonators, so they are safe.

"We let our imaginations go wild," Carey said. "The types of improvised explosive devices are endless."

So are possible solutions, at least in theory. That's where the Transportation Security Laboratory comes in. Scientists here dream up ways an enemy might slip a weapon or a bomb onto a plane, and then try to build defenses to detect or counter the danger.

The work is part cutting-edge science, part Maxwell Smart.

Staffers have experimented by exploding more than 200 bombs on junked jetliners. They also have filled a warehouse with nearly 10,000 lost or abandoned suitcases and other packed luggage.

"We build bombs in them" and run them through airport-style screening machines, said Susan Hallowell, the lab director. If a bomb escapes detection, technicians try to figure out why and how to catch it next time. "We call it the art of bagology."

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Most important, the lab evaluates and certifies all equipment purchased from outside vendors to search, sniff or scan passengers and their luggage at some 450 U.S. airports.

Dr. Colin Drury, distinguished professor emeritus of engineering at the State University of New York at Buffalo, calls the lab "one of the best in the world for the kind of work they do."

"They think broadly and have new ideas, and maybe 90% don't work," he said. "But that's OK, as long as 10% do."

About 125 chemists, physicists, engineers and others work in the lab's low-slung buildings on a wooded campus behind high fences and armed guards at the edge of the Atlantic City International Airport.

Inside is an odd mix of standard cubicles and blast-resistant rooms with thick steel doors and three reinforced walls. If an accident occurs, the design is supposed to channel the explosion to the fourth wall, which faces outside.

It's a work environment filled with painful reminders of how terrorism has changed the world.

Hallowell, 56, joined the lab as an analytic chemist when it first opened after the 1988 terrorist bombing of Pan Am Flight 103 over Lockerbie, Scotland. The lab still keeps a mock-up of the Semtex-filled boombox that brought the jet down, killing 270 people.

Hallowell was named director shortly after the Sept. 11, 2001, attacks, which turned the backwater lab into a small but crucial cog in what became the Homeland Security apparatus. Its budget has seesawed, but now is about \$45 million a year.

Like Q in the James Bond films, Hallowell clearly enjoys the unusual tools -- and the dark humor -- of her profession.

Showing a reporter around, she stops to take a woman's shiny black pump off a shelf. It hides an inert explosive in the heel.

"I've always liked this shoe," she said. "It's my size."

Much of the lab's work focuses on far-off technology.

In one room, chemist Inho Cho has put liquid explosive in a small purple bottle of NutriPals, a nutrition drink for children. It sits in a blast-proof, see-through box while he tries to determine how sensitive a screening portal must be to identify vapors that leak from the bottle.

"Maybe five years from now, the sensors will be sensitive enough," he said.

In another room, research physicist Rob Kleug uses medical technology to take what looks to be a brain scan of a peanut M&M. He measures the candy's mass density and effective atomic number, and compares the data to that of known explosives.

"We're still looking for practical applications," he said.

Nearby, physicist Jeff Barber aims very high-frequency radio waves at an explosive compound. He probes the interaction between molecules in an effort to produce a unique visual signature that can be compared with other materials.

"This is the final frontier," he said, showing a colorful graph on his computer monitor that represents TNT powder. "It's still in the experimental stage."

The lab's efforts to detect hidden threats increasingly competes with the need to protect the privacy of innocent travelers. As a result, the lab is caught in the latest controversy involving the Transportation Security Agency, the lab's chief customer.

Janet Napolitano, secretary of Homeland Security, announced this month that the TSA will deploy 150 backscatter imaging machines at checkpoints in major airports, including Los Angeles International Airport, adding to 46 tested in a pilot project.

The devices use a low-level X-ray beam that produces a three-dimensional image of each passenger -- every bump, bulge and private body part.

Such invasive imaging is "a virtual strip search," complained the American Civil Liberties Union and other privacy groups.

"These essentially allow the TSA to see under your clothing," said Michael Macleod-Ball, an ACLU official in Washington. "They see if you have a colostomy bag, even if you've had a mastectomy. It's a very intimate view of your person."

The House of Representatives has passed a TSA authorization bill that includes an amendment from Rep. Jason Chaffetz (R-Utah) to sharply limit use of whole-body imaging.

"Nobody needs to see my wife and kids naked to secure an airplane," Chaffetz said. The measure awaits a Senate vote.

The TSA argues such concerns are overwrought. Spokesman Greg Soule said the operator views an image that "resembles a chalk etching" and works from a remote, closed room, never seeing the actual passenger. Software blurs the faces, and the machine does not store or transmit the image, he said.

"You always have the option to go through a metal detector and undergo a pat-down," Soule added.

Another explosive detection system proved a \$36-million flop. In May, the TSA said it would phase out nearly 100 "puffer" portals that it had installed in the nation's busiest airports, and would not use dozens more it had already purchased.

The trace detection devices shoot jets of air at each traveler, then analyze the air for explosive particles. But the puffer units quickly clogged with dust and required expensive repairs.

"Everything works well in a nice, clean lab," admitted Hallowell. "But put it in an airport, you get dirt, vibrations and jet fumes. Miami is humid, Seattle is rainy, and let's not even talk about Minnesota."

The threat, meanwhile, is ever-changing. On Aug. 28, an Al Qaeda militant with a bomb in his rectum tried to assassinate Saudi Arabia's chief of counter-terrorism operations. The bomb apparently was triggered by cellphone. The explosion killed only the militant.

TSA officials say current detection systems probably would spot such a bomb, but the unusual case has sparked deep concern among international security experts.

The TSA's own experience is less than reassuring.

In July 2008, a man at Baltimore Washington International Airport similarly tried to conceal a canister of Mace pepper spray in his body. According to a TSA report of the incident, its officers "did not actually discover the can."

Instead, it "was so uncomfortable that the passenger left the security checkpoint for the nearest restroom. The passenger ran barefoot because his shoes had already been sent through the X-ray when he abandoned the line."

Police confiscated the Mace when the man emerged and he "was allowed to rebook but was later denied boarding when he showed up . . . with a bottle of lighter fluid in hand," the report adds.

"We've seen lots of weird stuff," said Lara Uselding, a TSA spokeswoman. "We've had people hide blocks of cheese in their bags with duct tape and wires attached to it. They're testing us."

And so the laboratory's search for security continues.

In a reinforced lab, explosives expert Theresa McGhee sews suicide vests with slabs of Semtex and other explosives, then wears the garment to see if she can foil the latest bomb detection systems.

"I'm both the designer and model," she said.

As Hollowell walked through the facility, she stopped by a pile of old-fashioned alarm clocks wired to sticks of fake dynamite, the cartoon image of a terrorist bomb.

"I call these our Road Runner bombs," she said with a laugh.

Her dream: to build a "tunnel of truth" in each airport lined with hidden sensors, scanners and rays. Passengers would get zapped and sniffed as they passed, and wouldn't need to take off their shoes, toss their liquids or anything else.

"The ideal is to get us back the freedoms we had before," Hollowell said.

"Wouldn't that be nice?"

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