U.S. House of Representatives
Committee on Science & Technology
Subcommittee on Investigations & Oversight

HEARING CHARTER

The Science of Security: Lessons Learned in Developing, Testing and Operating Advanced Radiation Monitors

Thursday, June 25, 2009
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

Purpose

The Subcommittee on Investigations and Oversight meets on June 25, 2009 to examine problems with the Department of Homeland Security's (DHS) efforts to acquire its next generation radiation monitors known as Advanced Spectroscopic Portals (ASPs). The ASP program has been under scrutiny since 2006 for failing to have clear-cut program requirements, an adequate test plan, sufficient timelines and development milestones or a transparent and comprehensive cost benefit analysis. Since the Domestic Nuclear Detection Office (DNDO), a DHS component, was created in 2005, they have been responsible for researching, developing, testing and managing the program.

The hearing will examine two new independent reports—one by the Government Accountability Office (GAO) and the other by the National Academy of Sciences—that identify ongoing and systematic problems in the testing and development of the ASP program. With an estimated program cost of $2-to-$3 billion the Subcommittee will evaluate the rigor of the overall test program, the technical abilities of the ASPs compared to existing radiation portal monitors and search for lessons from the ASP program that can be applied to future DHS acquisitions.

Background

Since the terrorist attacks of September 11, 2001, protecting the nation from a nuclear or radiological attack has been a top national security priority. In 2002, to help address this potential threat, the U.S. Customs and Border Protection (CBP) agency began deploying radiation monitors at U.S. border sites and ports of entry so its officers could screen the more than 23 million containers of cargo that enter the country every year for radiological and nuclear materials.

The equipment used to screen this cargo both then and now are polyvinyl toluene (PVT) or "plastic" portal monitors able to detect the presence of radioactive sources, but unable to identify the type of radiation present. The PVT monitors, while relatively inexpensive, robust and highly reliable, are unable to distinguish between radioactive sources that

might be used to construct a nuclear bomb, such as Highly Enriched Uranium (HEU), and non-threatening naturally occurring radiological materials (NORM) contained in ceramic tiles, zirconium sand or kitty liter, for instance. As a result, any time a PVT monitor detects a radioactive source the cargo is sent to "secondary" screening where CBP agents verify the detection of the radioactive source with a second PVT monitor and use handheld Radioactive Isotope Identification Devices called RIIDs to help identify the source of radiation.

This method of operation leads to many "secondary" inspections for naturally occurring radioactive material or radioactive material intended for benign purposes, such as radioactive medical isotopes. At the Los Angeles/Long Beach port of entry, for instance, PVT monitors routinely send up to 600 conveyances of cargo to secondary inspection each day. The RIIDs, used in secondary inspections however, are limited in their abilities to locate and identify potential threat material in large cargo containers. As a result, CBP officers can consult with scientists in CBP's Laboratories and Scientific Services (LSS) unit who can often help them enhance the ability to correctly identify the radioactive material of concern. As a last resort, CBP officers may physically search a cargo container by emptying its contents and closely scrutinizing it for potentially dangerous radioactive material.

If terrorists were to try to smuggle nuclear or radiological materials in containerized cargo—and there are ample other pathways for such smuggling—they would likely try to shield or "mask" those materials in an attempt to make it more difficult to detect, identify and locate the material of concern. Shielding requires that lead or steal or other types of metal enclose the radioisotopes to hide its radioactive signature. Potential terrorists may also attempt to "mask" threatening radioactive material by placing it together with or alongside other non-threatening material that has a natural radioactive signature, such as ceramic material, kitty liter or even bananas. Most nuclear security experts believe smuggled radioactive or nuclear material would be both shielded and masked in order to conceal it from being located and properly identified. Obviously, these efforts would make it harder to detect.

In order to help both improve the flow of commerce by eliminating many of the false alarms that send cargo for secondary screening and to more accurately identify radioactive or nuclear material, the Department of Homeland Security (DHS) began developing Advanced Spectroscopic Portals (ASPs) in 2004. The ASPs were intended to both detect and identify radioactive material. In April 2005, the Domestic Nuclear Detection Office was created by National Security Presidential Directive-43/Homeland Security Presidential Directive-14 to, among other things, research, develop, test and acquire radiation detection equipment to be used by CBP and other federal agencies. The office was not formally established until October 2006 under the SAFE Port Act.

From the very start of the ASP program, DNDO seemed to push for acquisition decisions well before the technology had demonstrated that it could live up to its promise. On July 14, 2006, Secretary of Homeland Security Michael Chertoff and the Director of DNDO, Vayl Oxford, announced contract awards to three companies worth an estimated $1.2

billion to develop the ASPs, including the Raytheon Company, from Massachusetts, the Thermo Electron Company from Santa Fe, New Mexico and Canberra Industries from Connecticut. Both Chertoff and Oxford held a press conference to announce the billion dollar contract awards just a few months after highly critical reviews of the ASPs' abilities by the GAO and the National Institute of Standards and Technology (NIST).

In March 2006, GAO said: "it is not clear that the benefits of the new portals would be worth any increased cost to the program." In June 2006, NIST submitted a report to DHS on results of side-by-side testing the previous year at the Nevada Test Site of both ASP and PVT systems. The DNDO had assumed that the ASPs would correctly identify HEU 95-percent of the time for both bare or unmasked HEU and HEU masked in a container with more benign radiological material. Yet, NIST found that the 3 best ASP systems tested identified HEU only 70-to-88-percent of the time. Their ability to identify "masked" HEU was much worse. The three ASP manufacturers did this only 53-percent of the time (Raytheon), 45-percent of the time (Thermo) and 17-percent of the time (Canberra). "Despite these results," the GAO found, "DNDO did not use the information from these tests in its cost-benefit analysis." DNDO claimed that they assumed they would meet the 95-percent performance level at some point in the future but provided no data on why they reached this conclusion, said GAO.

At the Chertoff-Oxford press conference in July 2006, then Secretary of Homeland Security, Michael Chertoff, said one of the key reasons for developing the ASPs and replacing the existing radiation monitors was to "have fewer false positives." In September 2007, Vayl Oxford, the director of DNDO reiterated that point in testimony to Congress where he emphasized that the ASPs would reduce the number of false alarms from the nearly 600 experienced each day by the PVTs at the port of Long Beach in California, for instance, to 20-to-25 per day with the new ASP monitors.

That was the hope, anyway. One of the criteria for ASP primary screening prior to certification of the new radiation monitors by the Secretary of Homeland Security, which is required by the appropriations committees, is that the ASPs must refer at least 80-percent fewer conveyances for further inspection than the PVTs. But in "field validation tests" earlier this year, by one of the two remaining contractors, the ASPs being tested sent *more* innocent radioactive shipments to secondary screening than the older PVT monitors. The cause of the high false positives was apparently due to a software glitch. This was a serious concern to the Customs and Border Protection personnel who will have to operate and maintain the ASPs if and when they are certified and deployed. The contractor has reportedly corrected the software issue and intends to return the ASPs to field validation testing next month.

Last fall, "integration" testing of the ASPs by the second remaining contractor was halted because of different technical troubles with its own software. The contractor corrected the problem and its ASP machines re-entered integration testing late last year. The contractor hopes to finish integration testing and begin field validation testing in early August. Still, both contractors are now many months behind schedule because technical issues have forced delays.

Virtually any high-technology research and development program experiences bumps in the road, technical troubles and occasional set-backs. However, well managed programs have clear technical requirements and strategic goals. They ensure that the new technology being developed is thoroughly tested and adequately integrated into the operational plans and procedures of those who must operate them in the field. When these vital components are short changed, when the test plan is insufficient and the program's research, development and testing methods are marred by scanty scientific rigor, the technical tools being developed are bound to suffer as a result. Cutting critical corners in the development process serves no one's interests. Yet, from the start many of the leaders of the ASP program at DHS seemed more interested in fielding this technology then in vigilantly validating its performance and effectiveness. At the July 2006 press conference unveiling the contractors on the ASP program, for instance, Vayl Oxford said: "the priority for the first year … is to get units out immediately." Three years later, none of these units have yet cleared field validation tests.

The policy governing the ASP program and the disproportionate focus on getting the ASP units into the field quickly never matched the multiple independent technical assessments of the technology being developed and tested. Over the past three years the Government Accountability Office has issued six reports on the ASP program and testified before Congress multiple times on this matter. Last year the Homeland Security Institute, a Federally Funded Research and Development Center for DHS, issued a report on the ASPs that also criticized the ASP test program, saying it provided insufficient data. The National Academy's of Science, which will release an interim report on the ASPs that they have just concluded this week, will provide testimony at the Subcommittee hearing that echoes many of the concerns raised by GAO over the years.

History of Problems

In 2006, the GAO issued a harsh critique of the DNDO's cost-benefit-analysis (CBA) of the ASPs. The DNDO analysis omitted critical test data that identified major technical problems with the ASPs and they drastically increased the procurement costs of the PVTs. In short, the GAO found DNDO's cost-benefit analysis was "incomplete," based on "unreliable" data and used "inflated cost estimates for PVT equipment."

In 2007, GAO concluded that tests of the ASPs conducted by DNDO were "biased" and "were not an objective and rigorous assessment of the ASPs' capabilities." The tests, for instance, used insufficient amounts of materials likely to mask or shield radioactive threat sources that terrorists might attempt to smuggle into the country. The tests, said GAO, did not attempt to test the limitations of the ASPs and "did not objectively test the performance" of currently used handheld radiation detectors or RIIDs.

Last year, in their own independent cost estimate of the ASP program, GAO found that the ASPs could cost about $3.1 billion, $1 billion more than the DNDO's estimate. The GAO also found that the DNDO had often changed its deployment strategy, eliminating plans to develop ASP portals for rail, airport and seaport cargo screening terminals, for

instance. As a result, GAO estimated the newest scaled back plan reduced the potential costs of the program to about $2 billion from 2008 to 2017. The only documentation that DNDO provided to GAO for this major change in the ASP program was a 1-page spread-sheet and DNDO has still not released an updated cost-benefit analysis of the program.

In addition, GAO criticized DNDO's decision not to complete computerized simulations or "injection studies" of the ASPs prior to certification by the Secretary of Homeland Security. The National Academy of Sciences has also found that computer modeling is critically important to the ASP program since running every potential radioactive smuggling scenario in live tests is unrealistic. Computer simulations would help provide a clearer assessment of the potential performance of the ASPs in actual smuggling incidents and effectiveness at identifying threatening radioactive material. DNDO, however, does not plan to complete the studies prior to the Secretary of Homeland Security's decision on certification, which DNDO expects to occur in October.

Problems Remain

While DNDO's past tests have been characterized as being unsound, incomplete and limited in scope, the GAO's most recent work on the ASP program does point to some improvements in the integrity of the latest round of tests. However, they also pinpointed significant technical limitations which have not yet been resolved.

The ASP portals did prove more effective than the PVTs in detecting HEU materials concealed by "light shielding." However, differences between the ASPs and PVTs became less notable when shielding was slightly increased or decreased. In past tests there was virtually no difference in the performance of the two machines with regard to detecting other kinds of radioactive isotopes, such as those used for medical or industrial purposes, according to the GAO, except in one case where the ASPs performed worse than the PVTs. Whether these other forms of radioactive sources are sensed by a PVT or ASP machine they all require secondary inspection to determine why a payload contains radioactive material. In detecting HEU, the ASPs performed better only in one narrowly defined scenario, which many experts see as an unrealistic portrayal of a true attempted nuclear smuggling incident. None of the tests run by DNDO, for instance, included scenarios that utilized both "shielding" and "masking" as a means of attempting to smuggle radioactive or nuclear material.

In addition, GAO and others have faulted DNDO for not focusing enough on attempting to improve the current radiation portal monitor program. Instead, DNDO has been nearly single-mindedly focused on developing Advanced Spectroscopic Portals at the expense of other far simpler alternatives. Surprisingly, for instance, DNDO has not completed efforts to improve the performance of PVTs by a method called Energy Windowing that could provide them with some limited, but enhanced, performance. Energy Windowing efforts are controversial and are believed to only provide modest enhancements to the performance of PVT's. But both GAO and CBP has been pushing DNDO to do more on this front for years. In addition, DNDO has not made efforts to upgrade the software in

the handheld radiation detection units known as RIIDs that could also provide a far less expensive alternative to enhancing the operational effectiveness of radiation monitors.

Because both remaining ASP contractors suffered from serious technical problems in their last round of testing, Customs and Border Protection (CBP) agency personnel fear that if the ASPs are certified, procured and deployed that they will encounter many problems in the field that will negatively impact their day-to-day operations and perhaps the technical effectiveness of the current radiation monitoring program to actually detect illicit nuclear or radiological material coming into the country. The GAO, National Academy of Sciences and others have also criticized DNDO for not seeking input from CBP officials on the ASP program from the start. The relationship has improved and DNDO does attempt to include CBP in critical decisions regarding the ASP program today. But many critics say perhaps one of DNDO's biggest failures was the fact that they did not do this from the beginning, seeking input from the operational users of the technology that DNDO was tasked to research, test and develop.

As a result of all of these issues, the ASPs continue to suffer from key questions about their ability to provide significant improved performance over existing radiation detection equipment currently fielded at U.S. ports. The Department of Homeland Security has already spent more than $235 million on the ASP program. But if the Secretary of Homeland Security certifies that the ASP monitors are worth investing in this fall – just three to four months from now – then $2 billion more may be invested to procure ASP radiation monitors. Yet, given the continued criticism of the narrowly focused and inadequate ASP test program, the limited technical improvements they may offer over current radiation monitors and significant increased costs to maintain and operate the ASPs compared to the PVTs, the success of the program remains in doubt.

Key Issues

- **Go Slow.** Uncovering and resolving technical problems once newly developed radiation monitors are fielded may hinder the ability to detect and identify radioactive or nuclear material that poses a potential threat. It could disrupt operations at U.S. borders and ports of entry curtailing the flow of commerce and it will cost more to rectify these problems in the field, rather than in the laboratory or at the test range. Yet, rather than carefully testing and validating the performance and effectiveness of the ASP monitors before a major procurement decision is made DHS has continually sought to get the ASPs into the field in spite of critical technical flaws identified during testing.

- **Cost Benefit Analysis.** Even if the technical abilities of the ASPs are proven, their relative technical capabilities and increased costs must be carefully weighed in comparison to the existing radiation monitoring system in place today. Replacing a proven, less-costly system that has the confidence of its operators, must be given careful consideration. The DNDO has not yet provided an updated cost-benefit-analysis that would validate a decision to procure the multibillion dollar ASP equipment.

- **Judging Performance.** As the House Committee on Appropriations has said in the past, procurement of the Advanced Spectroscopic Portal monitors should not proceed until they are deemed to add a "significant increase in operational effectiveness" over the current PVT system already in place. Last July, CBP, DNDO and the DHS management directorate jointly issued criteria for determining this increase in effectiveness in both "primary" and "secondary" screening. In primary screening the criteria requires ASPs to detect potential threats as well as or better than PVTs, show improved detection of Highly Enriched Uranium and reduce innocent alarms. In secondary screening the criteria requires ASPs to reduce the probability of misidentifying special nuclear material (HEU or plutonium) and reduce the average time to conduct secondary screenings. The Secretary of Homeland Security must certify to Congress that the ASPs have met these criteria before funding for full-scale procurement of the ASPs goes forward. However, the criteria to measure this improvement are weak and rather vague.

- **Lessons Learned.** The Department of Homeland Security must make greater efforts to avoid rushing to acquisition decisions when the R&D is incomplete. With ASPs, the research and development program itself has been hindered by a lack of rigorous scientific evaluations, and undemanding testing protocols. Moving to acquire systems plagued by such problems may endanger security and significantly increase the costs of the program. A review of DHS's major programs by GAO last November found that 45 of 48 major programs did not adhere to the agency's own investment review process that helps provide appropriate oversight to address cost, schedule and performance problems. In FY2008, the review found, DHS spent $147.5 million on the ASP program despite the fact it did not have a mission needs statement. The program also lacked operational requirements documents and an acquisition program baseline.

Witnesses

Panel I:

Mr. Gene Aloise, *Director, Natural Resources and Environment, Government Accountability Office*

Dr. Micah Lowenthal, *Division on Earth and Life Studies***,** *Nuclear and Radiation Studies Board***,** *National Research Council***,** *The National Academy of Sciences*

Panel II:

Dr. William Hagan, Acting Deputy Director, Domestic Nuclear Detection Office (DNDO), Department of Homeland Security (DHS)

Mr. Todd C. Owen, Acting Deputy Assistant Commissioner, Office of Field Operations, U.S. Customs & Border Protection (CBP), Department of Homeland Security (DHS)