Opening Statement

Of

Mr. Vayl S. Oxford

Director, Domestic Nuclear Detection Office

Department of Homeland Security

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"Nuclear Smuggling Detection: Recent Tests of

Advanced Spectroscopic Portal Monitors"

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Introduction

Good morning, Chairman Langevin, Ranking Member McCaul, and distinguished members of the subcommittee. As Director of the Domestic Nuclear Detection Office (DNDO), my office is responsible for developing new technologies and also ensuring that we deploy detection systems properly across the domestic nuclear detection architecture. I would like to thank the committee for the opportunity to discuss recent progress in the development of the next generation of radiation portal monitors (RPMs), or Advanced Spectroscopic Portal (ASP) systems. My testimony today will focus principally on the recently released Phase III Test Report, the Final Report of the ASP Independent Review Team (ASP-IRT), and the steps we will take to make a certification and production recommendation to the Secretary.

Historic Context

Countering the threat of nuclear terrorism is one of the top priorities for the Department of Homeland Security (DHS). DNDO is the lead agency responsible for the development, acquisition, and deployment of radiation detection equipment to support this mission within the Department. The ASP program is one of the programs DNDO has begun to improve radiation detection tools for operators, in this case Customs and Border Protection (CBP) Officers.

Considerable progress has already been made using currently available technology. At ports of entry (POEs), RPMs are typically installed in a primary scanning location to detect the presence of radiation in cargo and vehicles. CBP operates additional RPMs and handheld radioisotopic identification devices (RIIDs) in secondary scanning locations to further investigate alarms originating in primary and identify the specific source of the radiation detected. As of February 8, 2008, 100% of all incoming cargo on the southern border is being scanned for the presence of radiological or nuclear material, as well as 98% at the Nation's seaports, and 91% on the northern border. However, much work remains to close enduring gaps at many small border crossings along the northern border, as well as at small seaports. In addition, limits in the capabilities of current systems continue to present technical and operational challenges to those using the equipment.

Unlike current systems which detect and identify radiation sources in a two-step process, ASP technology uses the radiation spectrum from the inspected material to make a single detection and identification decision. DNDO has maintained that this ability to differentiate between threat material and naturally occurring radioactive material (NORM) will reduce the number of alarms due to non-threat sources, reduce the number of containers and vehicles sent to secondary inspection, and dramatically improve the probability of correctly identifying and interdicting smuggled nuclear material during secondary inspections.

In 2006, the Congress requested that DNDO complete a cost-benefit analysis of ASP systems, which DNDO subsequently issued in June 2006. In a later report (GAO 07-133R), the Government Accountability Office (GAO) raised concerns about performance and cost assumptions included in the DNDO cost-benefit analysis, and the Congress included further restrictions in the FY 2007 Appropriations Act (P.L. 109-295), directing that, "none of the funds appropriated under this heading shall be obligated for full scale procurement of [ASP] monitors until the Secretary of Homeland Security has certified… that a significant increase in operational effectiveness will be achieved."

In order to provide the Secretary with all necessary information prior to a certification decision, DNDO launched a substantial test campaign from February 2007 through September 2007. This included three separate test series conducted at the Nevada Test Site (NTS), including the Phase III testing captured in the report that we are discussing today, as well as contractor verification testing, stream of commerce testing at the New York Container Terminal (NYCT), integration testing at the Pacific Northwest National Laboratory (PNNL), and field validation at eight operational sites. In addition, in late July 2007, Secretary Chertoff notified the Congress of his intent to "assemble a highly experienced team" to perform "an independent review of the [ASP] test procedures, test results, [and] associated technology assessments." This group, known as the ASP-IRT, delivered a report to Elaine Duke, the DHS Deputy Under Secretary for Management, on February 20, 2008. The ASP-IRT Report is the second document under discussion today.

Phase III Test Report – Introduction

The Phase III Test Campaign, conducted at NTS in March 2007, was part of a larger series of tests conducted throughout 2007, designed to evaluate ASP performance. Specifically, Phase III testing was intended to collect data from challenging detection or identification cases, beyond those included in Phase I testing at NTS earlier in the year. In addition, Phase III testing was to support the development of concepts of operations, and provide an additional data collection opportunity for continued vendor development of improved detection and identification algorithms. Phase III testing was conducted in accordance with test plans developed by DNDO, in partnership with the National Institute of Standards and Technology (NIST), CBP and, to a limited extent, the Department of Energy (DOE) and its labs. The test plan included the incorporation of a variety of source and shielding configurations, and, in particular, configurations that were often more difficult than "guidance" detection goals. This point is particularly important when analyzing the results of the test.

Phase III Test Report – Objectives and Results

The Phase III Test Campaign was designed to evaluate several aspects of ASP system performance, with five primary objectives. Before discussing the objectives and results, it is necessary to provide several caveats that relate to the way the tests were designed, and how the specific objectives of the test affected the interpretation of the results obtained. First, it is important to reiterate that results indicating that ASP systems did not detect or identify some specific cases do not indicate that ASP systems did not work as designed. ASP systems are designed to operate to certain design thresholds. In some instances, Phase III test sources intentionally exceeded those thresholds to evaluate how far ASP performance continues. For instance, a number of test sources were selected that were shielded beyond amounts identified in government requirements, for the express purpose of understanding where ASP capabilities begin to "fall off." The fact that ASP systems functioned beyond specified requirements should be considered a positive sign, rather than a sign of inherent flaws.

Second, Phase III tests were intended to help DNDO and CBP better understand the full range of ASP system performance, and results will continue to guide further development efforts. Since testing in early 2007, DNDO has provided results as feedback to the ASP vendors, and they have incorporated this data into subsequent design improvements. These improvements will be evaluated through additional test campaigns scheduled for this year.

Finally, detailed Phase III results are classified at the SECRET level. Because individual results reveal vulnerabilities to both systems that are and will be deployed, performance of systems against specific sources cannot be discussed in an open setting. The results that follow have been intentionally generalized to avoid discussion of specific performance capabilities for systems. DNDO has previously provided classified test results to the Committee staff. DNDO would be happy to provide the same information to Committee members in an appropriate environment.

Detection sensitivity for plutonium surrogate – The detection sensitivity of ASP systems was measured against a plutonium "surrogate," or a source that was designed to mimic the detectable signature of plutonium. This objective was specifically focused on ensuring that ASP systems met the CBP requirement that they be at least as sensitive as current-generation polyvinyl toluene (PVT) -based systems. ASP detection sensitivities were measured against PVT-based systems set at existing operational thresholds.

For this representative source, ASP systems were more sensitive than PVT-based systems when operating at existing operational thresholds. As such, testing met the objective of assessing that ASP systems did not degrade detection performance, as compared to current systems.

Relative performance as a function of source categories – Phase III testing sought to compare relative performance of various ASP systems as a function of source categories. Source categories included bare, shielded, and "masked" special nuclear materials, bare, shielded and "masked" industrial sources, and medical isotopes. In particular, this objective sought to identify any significant variation in performance between each ASP vendor design. Additionally, detection performance was also compared to PVT-based systems, and identification performance was compared to current-generation sodium iodide (NaI) –based handheld detectors that are currently used to conduct secondary inspections.

Due to the number of source categories evaluated as part of this objective, results are more complicated than those associated with other objectives. While on average no ASP system significantly outperformed the others with regard to detecting sources passing through portals at either five or two miles per hour, there were differences in system performance when evaluated against each source.

With regard to comparisons between PVT-based and ASP systems, ASP systems outperformed PVT-based systems in detecting bare special nuclear materials, and both types of systems performed similarly against shielded special nuclear materials. "Masked" special nuclear materials resulted in higher alarm rates for PVT-based systems than ASP systems. Similarly, PVT-based systems demonstrated higher alarm rates for medical isotopes and industrial sources, though this was due to ASP decision software that categorized smaller sources as "non-threats." Based on requests from CBP, revisions have since been made to ASP algorithms so that industrial sources will be referred for secondary scanning. Finally, and significantly, ASP systems outperformed handheld RIIDs in identifying all source categories, with the exception of bare industrial sources. Due to the extremely high signal strengths associated with industrial sources, performance between ASP systems and RIIDs was comparable in that instance.

Effects of shielding on system performance – This test campaign sought to provide preliminary measurements of the effects of shielding materials on system performance. In particular, tests evaluated the difference in ASP system response when different types of sources, including special nuclear materials, were placed inside varying amounts of shielding. For the purposes of this objective, system "response" included both detection and identification performance.

As expected, all systems experienced difficulty in detecting and identifying certain heavily shielded materials, which results in signal strengths significantly below current "guidance" levels and requirements. This is consistent with performance of all passive detection systems. However, ASP systems were able to identify sources when placed inside almost all but the thickest shielding configuration tested.

Relative performance for combined sources – Phase III testing evaluated the relative performance of ASP systems against "combined sources," where more than one emitting isotope was present. This portion of Phase III testing was designed to provide additional data collection opportunities for ASP vendors, in support of algorithm improvements. This testing was not designed to provide conclusive data as to the performance of ASP systems against "masked" sources.

Phase III testing highlighted several areas where further study and algorithm development are required to reduce vulnerabilities. This data was provided to the ASP vendors, and software improvements are being incorporated into ASP revisions. In addition, the use of high-purity germanium-based systems, when operated in a "wait-in mode," showed slightly better performance than other systems. However, these initial results are an indicator of potential capabilities, rather than proof of superior performance.

Secondary screening for concepts of operations development – Additional evaluations were completed to assess varying concepts of operations for secondary scanning. ASP system performance was evaluated as a function of varying speeds and "dwell times," or the amount of time that a source was present within the portal. Specifically, measurements were conducted as sources moved at several pre-set speeds through the portals, as well as instances where sources were stopped within the portal for a defined amount of time.

The evaluations of concepts of operations demonstrated that scanning at two miles per hour, the current concept of operations for secondary scanning, could be sufficient for many source configurations. Results also indicated that longer dwell times for measurements may add value for the more challenging cases. However, it was not obvious that "wait-in mode" concepts of operations provide advantages for certain threats.

Phase III Test Report – Conclusion

The Phase III Test Campaign was a critical piece of a larger effort to evaluate the performance of ASP systems. Phase III testing was focused on testing the ASP systems with a significantly expanded variety of sources, shielding and "masking" configurations, and concepts of operations. The results have provided an additional data set in the on-going comparison of ASP performance to current systems. At the same time, the data gained from Phase III testing has limits, and it is critical that results are interpreted in the context of the original test objectives.

ASP-IRT Report – Introduction

The ASP-IRT was tasked with providing two elements of assessment: (1) "the testing approach, from contractor testing through operational testing, processes employed, specifications, test procedures, and analysis methods;" and (2) "the probability of success to detect and identify radiation and nuclear threats and assess the performance of the ASP [systems] compared to the first generation systems." The ASP-IRT Report was a culmination of analyses aimed at assessing these two elements, conducted from August 2007 through February 2008. These analyses were based on information provided by DNDO and CBP, as well as other outside sources. This information included DNDO test plans, test reports from several ASP evaluations, and numerous discussions with officials from both DNDO and CBP. However, the analysis and conclusions reached were completely independent of either DNDO or CBP, and the resulting conclusions reflected the assessment of the ASP-IRT members.

ASP-IRT Report – Initial Findings

The ASP-IRT Report includes an Executive Summary which highlights conclusions of the document.

While the ASP-IRT did not concur with assertions that the GAO made in September 2007 (GAO-07-1247T) that ASP testing in February through September 2007 "used biased test methods that enhanced the performance of the ASPs," it did agree with other claims, including the fact that tests were "not designed to measure the range of ASP system performance." In addition, the ASP-IRT indicated concern that test results and measures of effectiveness were not properly linked to operational outcomes, which led to difficulties in developing conclusions from the results. Fundamentally, the ASP-IRT asserted that testing to date was "properly characterized as Developmental Test and Evaluation. Independent Operational Testing has not been conducted."

In evaluating the performance of ASP systems directly, as compared to first generation systems, the ASP-IRT focused solely on ASP secondary scanning operations. Based on initial independent analysis, the ASP-IRT concluded that for the 13 objects used in Phase I testing, using ASP systems "did not affect the probability of a missed threat," when compared to current generation RIIDs. The ASP-IRT stated that this conclusion was based on the assumption that <u>all</u> RIID results of "unknown" where resolved by CBP Laboratory and Scientific Services (LSS), which provides technical support to CBP Officers at POEs. Yet, the ASP-IRT did allow that, based on an alternate assumption in which <u>many</u> RIID "unknown" alarms were resolved in the field, "it appears that ASP could substantially reduce the probability of entry for nine of the 13 test objects – for most, by at least 20 to 30 percent and possibly by 30 to 50 percent." The ASP-IRT was not able to draw any conclusion regarding the affect of ASP for the remaining four test objects.

In addition, based on first principles calculations, the ASP-IRT asserted that "the relative performance of the ASP [systems] and the RIID depends on several factors." The ASP-IRT argued that sample spectra from both systems would indicate comparable performance if a RIID is optimally placed. However, the ASP-IRT also acknowledged challenges associated with localizing radiation sources within a container, and the likelihood that operators may target the wrong "hot spot" for secondary inspection. The ASP-IRT also stated that "ASP performance could be improved in all cases by slowing the passage of the truck through the portal, though there would be increased costs." The ASP-IRT noted the benefit of improved consistency in scanning provided by ASP systems, as compared to RIIDS, especially by "reducing the impacts of operator inattention, fatigue, and variability of the placement of the RIID." Finally, the ASP-IRT also noted that "substituting the ASP for RIID in secondary screening would reduce the number of cases that qualify for referral to LSS under the current CBP CONOPS."

Additionally, the ASP-IRT made several additional observations based on their evaluation of the ASP program. These included a potential need for a more disciplined acquisition process to guide large DHS programs, an independent operational test and evaluation process, and a more well-defined requirements process to ensure that mission needs are properly accounted for in operational requirements.

ASP-IRT Report – DNDO and CBP Response to Initial Findings

DNDO recognizes the thoughtful evaluation that the ASP-IRT provided to the Department, and values the critiques that were included in the Final Report. Several of the concerns that were raised are valid and the Department is taking steps to address these issues.

Unfortunately, in some instances, analysis was limited to information immediately available, which was not in all cases a complete and accurate representation of events. In addition, due to the short time in which the ASP-IRT was tasked to produce a final report, subsequent iterations of information exchange that may have normally been performed were not feasible. Subsequently, staff from DNDO has met with ASP-IRT members, and many of the concerns that are outlined below were discussed. In many instances, it was acknowledged that as additional information that was provided to the ASP-IRT during their analysis, alternate conclusions emerged. In other instances, it appears that the ASP-IRT stands by its initial conclusions.

Limitation of analysis to secondary scanning operations – In Section I.C of the Report the ASP-IRT states that they "sought to determine the extent to which the use of the ASP would impact the frequency of nuisance alarms and the probability of illicit radioactive materials passing through [POEs] – taking into account other equipment with which it might be used, as well as other means of detecting the illicit materials." However, in the same section, the ASP-IRT explained that they solely "focused its analysis on the use of the ASP in the Secondary screening role." This approach to the analysis discounted the economic and time impacts of scanning delays due to high nuisance alarm rates in primary scanning. In addition, it also discounted the possibility that certain threats may never be referred to secondary screening. In the long term, DNDO and CBP expect that the greatest benefits of ASP technologies will be in these primary scanning operations, where DNDO testing at NYCT has already shown that ASP systems may reduce nuisance alarm rates by more than a factor of 10 (1.70% for PVT systems and 0.11% and 0.12% for two ASP systems). A reduction of secondary referral rates of this magnitude, when averaged over the entire volume of cargo containers entering the U.S. annually, would potentially result in hundreds of thousands fewer secondary inspections required each year. The savings that the elimination of these inspections would have in the efficient processing of trade and manpower resources of CBP should not be ignored in what is argued to be a "system-of-systems" analysis.

<u>*False dismissal rates in secondary inspections*</u> – In its "system-of-systems" approach, the ASP-IRT initially questioned the decision of DNDO to omit LSS analysis of RIID data from comparisons of system performance. DNDO has cited evidence that RIIDs produced "unknown" alarms in up to 60% of cases, leading to either increased requirements for physical inspections, or the potential for an inadvertent release of a threat. The ASP-IRT analysis instead assumed that all of these alarms would be sent to LSS for further analysis. The ASP-IRT raised questions about the validity of this assumption, based on contrary evidence from operational data, which indicated that actual LSS referral rates were less than one tenth of the expected rates, based on evaluations of RIIDs. However, while acknowledging this discrepancy, the ASP-IRT only asserted that, "If the ASP were to replace the RIID in Secondary screening, it seems likely that some fraction of these "unknown" cases would be properly resolved as NORM or else referred to LSS for resolution. However, based on the available data, we were not able to determine what that fraction would be."

The reality is that it is not operationally feasible to send all "unknown" alarms to LSS for additional analysis. Operational data indicates that only 3,000 alarms are sent to LSS annually – far less than the minimum of 40,000 annually predicted by the ASP-IRT. DNDO estimates indicate that using ASP systems in secondary scanning operations would reduce the number of alarms requiring LSS analysis to approximately 3,000 – 4,000 per year, a number manageable with current LSS resources. More importantly, this would allow *all* alarms that should be referred to LSS to be actually referred to LSS, ensuring that no threats are mistakenly released into the Nation under an "unknown" alarm, even when CBP CONOPs are followed.

<u>*First principles calculations of comparative performance*</u> – In addition to providing analyses of available test data, the ASP-IRT performed a series of "first principles" calculations which attempted to predict the performance of hypothetical ASP systems and RIIDs. These calculations focused on the theoretical signal-to-noise ratios of the two systems, based upon distances from source to detector, the size of the detector, and the time interval of the scan. The

ASP-IRT argues that the advantages provided by the additional detector size of ASP systems is, in some cases, outweighed by the shorter distance and longer scanning intervals provided by RIID systems. However, in initial calculations, the ASP-IRT assumed that RIIDs would be able to successfully locate the source "hot spot" and a lengthier (one to three minute) scan could be focused on that location, with a source to detector distance of one foot. The incorrect assumption that a RIID would be able to effectively localize and scan any source within one foot of a detector drastically affected the outcome, and significantly reduced the perceived improvements provided by ASP systems.

The reality is that the height of containers (up to 13.5 feet) and the requirement that an operator hold the RIID (limiting effective detector height to six to seven feet) make scanning the entire container surface with the RIID difficult. Additional calculations done by DNDO, and provided to the ASP-IRT, show that for sources located near the center of a loaded container the RIID is approximately as sensitive as the ASP but only over a 2-foot radius circle on the surface of the container. Outside of that radius, the sensitivity falls off drastically. This means that a single RIID measurement can only effectively scan approximately 2% of the area of the container. Test data indicate that it is difficult to accurately locate the correct "hotspot" at which to place the RIID, which further erodes the effectiveness of the unit. ASP systems, unlike RIIDs, stand 14 feet tall, and provide the ability to uniformly scan the entire contents of a container. In addition, this scan is performed in 15 seconds, as opposed to the one to three minutes per "hot spot" measurement by the RIID. To effectively scan the "entire" container with a RIID to the same consistency as an ASP would take approximately 1 hour, assuming only one minute per scan. While the ASP-IRT acknowledges some of these challenges in the Report, they also propose alternative solutions, such as improved RIID software, or gantry systems for consistent scanning of containers. However, these calculations show that ASP is the solution that will effectively scan an entire container *quickly*, because even RIIDs with improved software (one recommendation of the ASP-IRT) would still be limited in effective detection ranges based on the smaller detector size and probability of localization error.

<u>Other effects that differentiate ASP Systems and RIIDs</u> – Finally, in addition to the issues highlighted above, DNDO has noted several other issues which affect the comparison of ASP

systems and RIIDs that were not accounted for by the ASP-IRT. First, the ASP-IRT Report fails to account for the possibility of multiple “hot spots” in a single cargo container. Because CBP protocols require Officers to scan the entire container and then focus on the regions of highest detected radiation, threat materials with lower emissions could be missed and more intensive scans instead focused on other “hotter” locations within a container. Again, the ability of ASP systems to scan an entire container in a uniform fashion provides the ability to identify threats throughout a container, rather than just those that emit the most radiation. Secondly, while the ASP-IRT highlighted the importance of background radiation and the confounding effects that it has on radiation identification, their analysis does not account for the fact that ASP systems are designed to shield background radiation from interfering with the detection of sources in the containers being scanned. While ASP systems are shielded by one inch of steel on the back and sides of the detector, RIIDs have no similar shielding to focus the detection containers. While difficult to quantify, this shielding provides measurable improvement in the ASP signal-to-noise ratio when compared to RIIDs. While the ASP-IRT acknowledged these additional effects, it did not adopt firm positions as to the associated benefits.

ASP-IRT Report – Conclusion

The ASP-IRT Report provides a valuable independent assessment of the ASP program, and will serve as an important source of information in the eventual decision to certify ASP systems. However, their analysis was limited in the scope of information made available, which in some instances may have resulted in conclusions contrary to those that would have been reached if more information were available. Since that time, DNDO has met with the ASP-IRT and provided additional information and discussed differences in conclusions reached by each party. In some instances, DNDO analysis has shown that ASP-IRT conclusions provided unnecessarily limited appreciation for the improvements that ASP systems offer. These issues include the ASP-IRT decision to focus solely on ASP improvements to secondary scanning operations, assumptions made by the ASP-IRT concerning referrals of “unknown” secondary alarms to LSS, the probability of localization error on first principles analysis of RIID performance, and other issues which differentiate ASP systems and RIIDs. DNDO believes that when these issues are considered, ASP systems clearly provide an improvement in operational effectiveness when compared to current systems.

DNDO looks forward to continuing to work with CBP and other partners within and beyond DHS to improve the Nation's ability to detect radiological and nuclear threats at our ports and borders. DHS is facing an enormous challenge at our ports and borders as it struggles to balance the flow of goods and commerce with the need to sufficiently scan cargo for radiological or nuclear threats as it enters our Nation. The technologies that DNDO is pursuing in the ASP program are a critical component in addressing that challenge.

Conclusion

I am confident that our plan for the development and evaluation of ASP systems is sound. The Phase III test results show promise from ASP systems, and the ASP-IRT has provided a valuable assessment of the program to date.

I welcome and appreciate the Committees active engagement with this program, and look forward to continuing our cooperation as we move forward together. This concludes my prepared statement. Chairman Langevin, Ranking Member McCaul, and Members of the Subcommittee, I thank you for your attention and will be happy to answer any questions that you may have.