

Statement of

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**on
The Utility of
Advanced Spectroscopic Portal Monitors
for Interdicting WMD**

**Before the
Committee on Homeland Security and Governmental Affairs
United States Senate
Washington, D.C.**



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Introduction. Mr. Chairman and members of the Committee, thank you for providing the Natural Resources Defense Council (NRDC) the opportunity to present its views on the Advanced Spectroscopic Portal (ASP) systems that are currently being considered for deployment at ports and border crossings. NRDC is a national, non-profit organization of scientists, lawyers, and environmental specialists, dedicated to protecting public health and the environment. Founded in 1970, NRDC serves more than 1.2 million members and supporters with offices in New York, Washington, Los Angeles, San Francisco, Chicago and Beijing. I am a nuclear physicist and former director of NRDC's Nuclear Program.

Before summarizing our conclusions, please permit me to submit for the record a recent article summarizing our analysis of the issue before us, namely, "Detecting Nuclear Smuggling," written by my colleague Matthew G. McKinzie and myself, which appeared in the April 2008 issue of the *Scientific American*. I also wish to submit a rulemaking petition we presented to the Nuclear Regulatory Commission (Docket No. PRM-50-90) that seeks to establish a date after which the Commission will no longer license the civil use of highly enriched uranium (HEU), along with the Federal Register Notices describing the petition and requesting public comments (73 FR 30321-30322 (27 May 2008) and 73 FR 49965 (25 Aug 2008)).

Summary of Conclusions.

1. Advanced Spectroscopic Portal (ASP) monitors are not cost-effective. Additional units should not be purchased. The limited number of ASP monitors already purchased should be used for continued field testing and research and development.
2. A crude nuclear device constructed with highly enriched uranium (HEU) poses the greatest risk of mass destruction by terrorists.
3. Neither the ASPs, nor the currently deployed Radiation Portal Monitors (RPMs), can reliably detect lightly-shielded, significant quantities of HEU.
4. The ASPs, if deployed for primary screening, will not significantly increase the probability of detection of HEU over the probability of detecting HEU using the currently deployed RPMs.
5. The ASPs, if deployed for secondary screening, will not increase the probability of detection of HEU or other materials at all over the probability of detection using the currently deployed RPMs, unless the alarm threshold of the RPMs is lowered, causing the false alarm rate of the RPMs to increase. Even then, the ASPs will not *significantly* increase the probability of detecting HEU.
6. Plutonium is detected primarily by neutron detectors, therefore the spectroscopic detectors of the ASP which do not detect neutrons will not increase the probability of detecting plutonium. Consequently, the ASPs will not significantly increase the probability of detecting plutonium.
7. There is no evidence that the potential benefits of the ASP monitors in reducing the false alarm rate and improving the accuracy of alarm resolution is cost-

- effective or now necessary to reduce delays to commerce from the screening process.
8. For the purpose of certifying the ASPs, the Department of Homeland Security (DHS) has defined “significant increase in operational effectiveness”—the certification requirement under the FY2007 Homeland Security Appropriations Act (P.L. 109-295)—primarily in terms of its ability to reduce the false alarm rate, rather than in terms of its ability to increase the probability of detection of HEU. Consequently, the process has been rigged to insure certification of the ASP even though (1) they will not significantly increase the probability of detecting nuclear weapon-usable HEU and plutonium, and (2) a reduction in the false alarm rate and an improvement in the accuracy of alarm resolution is not cost-effective.
 9. The Executive Branch and the Congress currently lack an office or interagency process to establish priorities for funding Federal programs to reduce the threat of terrorist use of weapons of mass destruction.
 10. Too much emphasis has been placed on radiation detector deployment at border crossings, when the most effective tools for combating terrorist use of weapons of mass destruction are:
 - a. eliminating and securing weapon-usable materials at their source
 - b. good intelligence
 - c. good police work, and
 - d. response planning and training to improved mitigation and recovery capabilities.
 11. The sources of HEU that represent the greatest risk of diversion are associated with civil and naval fuel activities.
 12. The highest priorities of the United States in this area should be to eliminate the civil use of HEU globally, blend down excess military stocks, and increase security on the remaining military stocks.
 13. In this regard the President should declare, and back with the full weight of our diplomacy, that the United States seeks—in the interest of and in cooperation with all nations—to achieve as quickly as possible a global ban on the civil use of HEU. For its part the United States should more rapidly convert all research and test reactors and medical isotope targets from HEU to low enriched uranium (LEU).
 14. The President should request that the Nuclear Regulatory Commission (NRC) change its regulations (10 CFR 50.64, 10 CFR 50.2, *inter alia*) so that it no longer preserves the option of licensing civil use of HEU, except for the purpose of down-blending existing stock of HEU, and to permit for a limited period of time HEU at facilities where there is a good-faith ongoing effort to convert from HEU to LEU.

Analysis and Discussion.

I will elaborate on some of the conclusions listed above.

1. Advanced Spectroscopic Portal (ASP) monitors are not cost-effective. Additional units should not be purchased. The limited number of ASP monitors already purchased should be used for continued field testing and research and development.

These conclusions follow from our assessment that ASPs cannot reliably detect HEU, as enumerated below, and from our view that the deployment of the ASPs cannot be justified on the basis that they will reduce the false alarm rate and accuracy of alarm resolution.

2. A crude nuclear device constructed with HEU poses the greatest risk of mass destruction by terrorists.

A simple, gun-like improvised nuclear bomb design involves two subcritical pieces of HEU that are driven together so that they form a supercritical mass. The “Little Boy” atom bomb dropped on Hiroshima assembled about 65 kilograms of HEU within a millisecond by firing one subcritical piece down a gun barrel at a second subcritical piece. In 1987 Nobel laureate physicist and Manhattan Project scientist Luis Alvarez noted that if terrorists had modern weapons-grade uranium, they “would have a good chance of setting off a high-yield explosion simply by dropping one half of the material on the other half.” Our own technical analysis of this issue confirms Alvarez’s statement. Also, for reasons set forth in our *Scientific American* article, HEU represents a greater risk than plutonium. Designing an HEU bomb seems shockingly simple and the only substantial impediment for terrorists is secretly gathering sufficient material.

As noted by Vayl Oxford in his September 18, 2007 testimony before the Subcommittee on Oversight and Investigations of the House Committee on Energy and Commerce, according to the 9/11 Commission, one of the gravest threats facing the Nation is the possibility of a nuclear threat. The Defense Science Board’s (DSB’s) 2005 Summer Study on “Reducing Vulnerabilities to Weapons of Mass Destruction”, Volume 1, May 2007, analyzed fourteen scenarios that span nuclear, biological, chemical and radiological threats. The only nuclear threat analyzed by the DSB where radiological monitoring could potentially play a role in interdiction was an “improvised nuclear device using highly enriched uranium stolen from the former Soviet Union.”

3. Neither the ASPs, nor the currently deployed RPMs, can reliably detect lightly-shielded, significant quantities of HEU.

To reveal radioactive material, the radiation must first be detected, but also the signals must be discernible from those produced by harmless radioactive substances in the cargo. Two significant factors can reduce a detector’s ability to detect the signal of HEU: a) shielding that absorbs radiation, and b) the distance between the source and detector. These factors present an insurmountable impediment for both RPMs and ASPs to reliably detect HEU. The basis for this conclusion is summarized in Thomas B. Cochran and Matthew G. McKinzie, “Detecting Nuclear Smuggling,” *Scientific American*, April 2008, which I have submitted for the record. More detailed technical documentation for these conclusions is available to the committee should it desire to receive it.

4. The ASPs, if deployed for primary screening, will not significantly increase the probability of detection of HEU over the probability of detecting HEU using the currently deployed RPMs.

The ASPs use sodium-iodide (Na-I) or other crystals to provide the spectroscopic capability of the ASPs. The mass and volume of these crystals is substantially smaller than the mass and volume of the plastic scintillation detector material used in the RPMs (and in the ASPs). Although the background count rate in the energy channels of the Na-I crystals is reduced over the background count rate of the plastic scintillators, this difference does not make up for the difference in the detector mass. Therefore if the ASPs are deployed for primary screening, their capabilities to flag HEU are practically identical to the RPMs.

5. The ASPs, if deployed for secondary screening, will not increase the probability of detection of HEU at all over the probability of detection using the currently deployed RPMs, unless the detection threshold of the RPMs is lowered, causing the false alarm rate of the RPMs to increase. Even then the ASPs will not *significantly* increase the probability of detecting HEU.

Since the HEU must be detected by the RPMs before the ASPs are utilized in a secondary screening mode, the ASPs cannot increase the probability of detecting the HEU. Note that David Huizenga, in his September 18, 2007 testimony before the Subcommittee On Oversight and Investigations of the House Committee on Energy and Commerce, was careful to say that the ASP monitors “will improve the rate and accuracy of alarm resolution.” Nowhere does he claim the ASP monitors will increase the probability of detection of HEU or other radioactive materials of concern.

6. Plutonium is detected primarily by neutron detectors. Therefore the spectroscopic detectors of the ASP which do not detect neutrons will not increase the probability of detecting plutonium.

While I do not have access to the ASP design data, and therefore could be mistaken, I am unaware of any significant improvement in the sensitivity of the helium-3 neutron detectors. In any case, since the improvised nuclear device detonation risk associated with HEU is much greater than the risk associated with plutonium, overall cost-effectiveness of the ASPs cannot be justified on the basis of a marginal improvement in the plutonium detection probability. To the best of my knowledge, the technical literature in this area exhibits no substantial concerns regarding the RPM systems to detect plutonium.

7. There is no evidence that the potential benefit of the ASP monitors in reducing the false alarm rate and improving the accuracy of alarm resolution is cost-effective or necessary to reduce delays to commerce from the screening process.

ASP monitors have the potential to reduce the false alarm rate over that of the currently deployed RPMs, irrespective of whether the ASPs replace the RPMs as the primary screening system, or serve as a secondary screening system augmenting the continued use of RPMs as the primary screening system. In either case, I am unaware of any analysis that demonstrates that reducing the false alarm rate using ASPs is cost-effective. There is no evidence that the quantified definition of “significant increase in operational

effectiveness” being used for certification was derived from a cost-benefit analysis based on a comparison of current versus expected delays in moving commerce under different assumptions about the rate and accuracy of alarm resolution. In our view, peer-reviewed analysis to answer this question is required but has not been performed or published.

8. For the purpose of certifying the ASPs, the Department of Homeland Security (DHS) has defined “significant increase in operational effectiveness”—the certification requirement under the FY2007 Homeland Security Appropriations Act (P.L. 109-295)—primarily in terms of its ability to reduce the false alarm rate, rather than in terms of its ability to increase the probability of detection of HEU. Consequently, the certification process has been rigged to insure certification of the ASP even though (1) they will not significantly increase the provability of detecting nuclear weapon-usable HEU and plutonium, and (2) a reduction in the false alarm rate and an improvement in the accuracy of alarm resolution is not cost-effective. Customs and Border Protection or DNDO can provide the test requirements used for defining “significant increase in operational effectiveness.” DNDO concluded ASP certification and deployment of ASPs was a vital priority *prior to* completing their testing.

9. and 10. The Executive Branch and the Congress currently lack an office or interagency process to establish priorities for funding Federal programs to reduce the threat of terrorist use of weapons of mass destruction. Too much emphasis has been placed on radiation detector deployment at border crossings, when the most effective tools for combating terrorist user of weapons of mass destruction are:

- a. eliminating and securing weapon-usable materials at their source**
- b. good intelligence**
- c. good police work, and**
- d. response planning and training to improved mitigation and recovery capabilities**

As noted by Dana A. Shea, a Specialist at the Congressional Research Service, in July 16, 2008 testimony before this committee, the Global Nuclear Detection Architecture is primarily a structure of nuclear detection systems. The U.S. Government lacks “an overarching plan to help guide how it will achieve a more comprehensive architecture.” Thus, prioritizing expenditures among radiological detection systems largely excludes trade-offs among intelligence, law enforcement, planning for response to nuclear events, and “first line of defense” programs to eliminate or secure nuclear source materials. Where is the evidence, for example, that spending some \$2 billion or more on ASP deployments is more cost-effective than investing these funds on efforts to accelerate the elimination of HEU sources and seeking a global ban on civil use of HEU? The Defense Science Board’s 2005 Summer Study, “Reducing Vulnerabilities to Weapons of Mass Destruction” identified six high payoff low-cost areas of recommendations that it believed would greatly reduce vulnerabilities to weapons of mass destruction. None involved improving the rate and accuracy of the alarm resolution of RPMs.

11. and 12. The sources of HEU that represent the greatest risk of diversion are associated with civil and naval fuel activities. The highest priority of the United

States should be to eliminate the civil use of HEU globally, blend down excess military stocks, and increase security on the remaining military stocks.

This can be deduced from an analysis of historical data on nuclear trafficking following the collapse of the Soviet Union. There is no evidence—at least not in the open literature—of the diversion of a nuclear weapon. As indicated by Senator Lieberman when he opened the hearings before this committee on July 16, 2008, “Between 1993 and 2006, there were 1080, confirmed incidents of illicit trafficking in nuclear materials. Eighteen of those cases involved weapons-grade materials, and another 124 involved material capable of making a so-called “dirty bomb” that would use conventional explosives to spread nuclear materials.” An analysis of this record, I believe, would show that the majority, if not all, of the 18 cases involving HEU or plutonium were from facilities using these materials for civil research or the production or use of naval or space reactor fuel. Few if any of these attempted diversions were from nuclear weapon production facilities. For reasons explained in our *Scientific American* article, HEU represents a greater threat than plutonium with regard to use by terrorists for construction of an improvised nuclear explosive.

13. and 14. In this regard the President should declare, and back with the full weight of our diplomacy, that the United States seeks—in the interest of and in cooperation with all nations—to achieve as quickly as possible a global ban on the civil use of HEU. For its part the United States should more rapidly convert all research and test reactors and medical isotope targets from HEU to low enriched uranium (LEU). The President should request that the Nuclear Regulatory Commission (NRC) change its regulations (10 CFR 50.64, 10 CFR 50.2, *inter alia*) so that it no longer preserves the option of licensing civil use of HEU, except for the purpose of down-blending existing stock of HEU, and to permit for a limited period of time HEU at facilities where there is a good-faith ongoing effort to convert from HEU to LEU.

Simply stated, if the HEU is eliminated it cannot be used to construct a nuclear explosive device. While it would not completely eliminate the threat, achieving, and even seeking a global ban on civil use of HEU would provide the greatest reduction in the risk associated with terrorist use of weapons of mass destruction.

Conclusion.

The RPMs have two problems. They cannot reliably detect lightly shielded HEU and they produce excessive false alarms. The ASP monitors are an attempt to solve the wrong problem, namely, reducing the false alarm rate of the RPMs, rather than increasing the probability of detection of HEU. In this regard, the ASPs are not cost-effective and more ASPs should not be purchased.

Because the RPMs do not reliably detect HEU, they are ineffective at reducing the U.S. national security risk due to nuclear terrorism. Correcting the wrong problem also does not reduce the risk. DHS hides these shortcomings by claiming the RPMs and ASPs are part of a layered defense, no part of which is 100 percent effective. While true, this does not imply that this or any other layer is cost-effective. The United States is spending billions of dollars on “scarecrows,” hoping the deployment of these ineffective systems

will convince the birds to fly to a different field. We can do better. We can, for example, call for a global ban on the production and use of HEU for civil purposes, as well as a ban on further production of HEU and plutonium for military purposes and apply the full weight of the government to achieve these goals. To protect the U.S. from terrorist nuclear attack, the country should forge a larger, more effective strategic plan with the highest priority given to eliminating civil use of HEU globally.