House Committee on Oversight and Government Reform,
Subcommittee on National Security and Foreign Affairs

"Oversight of Ballistic Missile Defense (Part 3):
Questions for the Missile Defense Agency"
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Prepared Remarks by
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Chairman Tierney, Representative Shays, distinguished Members of the Committee, I appreciate the opportunity to appear before you to support your examination of the Department of Defense missile defense programs.

I am chairman of High Frontier, a non-profit organization that has since the early 1980s advocated effective active defenses against ballistic missiles. We accept no funding from the Department of Defense, nor from any Defense Contractor engaged in missile defense activities.

In addition, I am Chairman Emeritus of Applied Research Associates, Inc., an independent contractor which works on national security issues, including for the Department of Defense, but I have avoided involvement with any work ARA may do related to missile defense issues so as to avoid any conflict of interest regarding my views on missile defense—sometimes to the chagrin of my ARA colleagues. The only missile defense related ARA work I know of involves high altitude physics important to the hardening of missile defense components to nuclear effects, and detailed lethality considerations important to modeling the intercept physics. The closest I come to missile defense programs in my personal ARA efforts is my work for the Department of Homeland Security (The Domestic Nuclear Detection Organization) and the Department of Defense (Defense Threat Reduction Agency) to develop technical and political-military concepts to counter the smuggling of nuclear weapons and materials into the United States.

I hold a PhD in engineering and have been involved since 1960 in a variety of technical and policy issues related to strategic offensive and defensive programs, from detailed technical research to supporting development of national security policies at senior levels. Regarding Ballistic Missile Defenses, I worked on Nike Zeus at Bell Labs in the early 1960s, helped set the criteria for the Safeguard system in the late 1960s, served in the mid-to-late 1970s on several Air Force Scientific Advisory Boards and Defense Science Boards that considered the possible role of missile defense in improving the survivability of our land-based ICBMs—and oversaw many of these activities as a Deputy Assistant Secretary of the Air Force with oversight responsibilities for Air Force strategic and space systems, including the development of penetration aids to defeat Soviet ballistic missile defenses. Among these projects was the development of the miniature homing vehicle eventually launched from an F-15 to shoot down a satellite in 1985—a proof-of-principle that we could "hit a bullet with a bullet."

As Assistant Director of the Arms Control and Disarmament Agency for Strategic Programs in the early to mid 1980s, I was responsible for backstopping our bilateral negotiations with the Soviet Union and led the interagency process at the Assistant Secretary level in developing the Reagan ASAT arms control policies. I was also involved at that level in developing our approaches to the START and INF negotiations and in dealing with associated verification issues—and, when the Nuclear and Space Talks began in 1985, served with the rank of Ambassador initially as Deputy Chief Negotiator and later as Chief Negotiator in the Geneva Defense and Space Talks, with responsibilities for defending President Reagan's Strategic Defense Initiative (SDI) against Soviet efforts to undercut the viability of that important program. In all, I spent five years in these negotiations, interacting regularly with Congress, the public, our allies, and, of course, the Soviets.

In 1990, Defense Secretary Dick Cheney asked me to lead a Presidentially mandated review of the SDI program and to recommend appropriate redirection in view of the then rapidly changing geopolitical scene, as the Soviet Union was disintegrating. I concluded that, in the post-Cold War world, the primary ballistic missile problem would be associated with the then-recognized growing problem of the proliferation of weapons of mass destruction and the means to deliver them, especially ballistic missiles. Thus, I recommended that SDI be redirected away from defending the United States homeland against a massive attack by thousands of nuclear reentry vehicles to protecting the United States and our overseas troops, allies and friends against limited ballistic missile attack—up to a couple of hundred reentry vehicles—and I advocated that we work with Russia to build such a global

system. This effort was intended to integrate both "Theater Missile Defense" and "National Missile Defense" into a single global system.

I still believe this "global defense" should be the goal of our missile defense programs, and that achieving it is feasible and affordable. The one extension of my 1990 vision is that I now include among the threats of concern terrorists who might launch SCUDs—or cruise missiles—from ships off our coasts.

Secretary Cheney then asked me to serve as SDI Director to develop and implement a plan to achieve this global defense objective—and I accepted his kind offer in mid-1990 and served in that post until January of 1993. During my comprehensive 1990 review and my tour as SDI Director, I think I was privy to all the classified information related to dealing with offensive countermeasures against all potential missile defense system concepts. However, I have not been briefed on any subsequent developments that might change the appraisal I then had—which remains the guiding light for my views on how truly effective defensive systems should be designed.

On the other hand, I do not believe modifications in the underlying technology can significantly affect what we have known for 50-years to be the fundamental technical requirements for a truly effective missile defense system. I'd like to review these basic considerations because I believe they are critically important in molding the most effective future missile defense programs.

Since the circa 1960 DARPA studies of the requirements for effective ballistic missile defenses, informed investigators have understood that a layered defense is required—not only to achieve many intercept attempts, but also to stress the attempts that dedicated designers of offensive ballistic missiles can be expected to make to penetrate the defense. Consider the three phases of a ballistic missile's flight and the associated distinctive measure-countermeasure characteristics:

- The *Boost-Phase* begins with the launch of the ballistic missile and ends when its rockets burn-out. During this period of flight, the threat rocket is very vulnerable to almost any perturbation, making it an attractive target; the challenge is for the defense to reach it in time. An intercept requires that the defense be based close enough to reach the attacking rocket before it burns out—for an ICBM in a matter of a few hundred seconds. For shorter range ballistic missiles, a boost phase intercept requires even closer proximity to meet shorter time constraints. To be close enough with a "hit-to-kill" kinetic energy interceptor is challenging for ground-based interceptors—e.g., getting the defense close enough to the launch site of a hostile adversary by

placing it on a neighbor's territory can pose a significant political problem. Locating air-based defenses—whether they employ kinetic hit-to-kill technology or directed energy (like the Airborne Laser)—close enough to be effective is perhaps easier, but may still pose difficult operational and/or political problems. Sea-based defenses may more easily be deployed close enough in international waters, but the offense can defeat their boost-phase potential if threat launch sites are sufficiently far inland. Only space-based defenses can assure a boost-phase intercept capability against essentially all threatening ballistic missiles with ranges greater than a few hundred miles.

- The *Midcourse Phase* begins at burn-out and extends to the time when the reentry vehicle(s) begin to reenter the Earth's atmosphere—for an ICBM about 20-minutes, a relatively long time for the defense in any basing mode to intercept the attacking ballistic missile/reentry vehicle. A complicating factor is that during this phase outside of the Earth's atmosphere, reentry vehicles and various other bodies—including decoys and various elements that may break away from the rocket and or reentry vehicle bus—travel at the same speed, and the resulting array of objects can create a significant discrimination problem. Defensive countermeasures include employing an array of pellets with the kill vehicle (like the pellets of a shotgun shell), or multiple very smart miniature hit-to-kill vehicles, or eventually the use of directed energy systems like lasers to perturb light weight decoys and expose a heavier reentry vehicle in the offensive threat "cloud." Still, assuring an effective midcourse defense is perhaps the most severe of all the measure-countermeasure challenges.
- During the *Terminal Phase*, beginning with reentry into the Earth's atmosphere, atmospheric drag will strip light-weight decoys and other elements away from the heavier attacking reentry vehicle, exposing it to substantially easier discrimination and intercept opportunities. The defense challenge is then assuring that the kill vehicle's sensors can acquire and guide the interceptor to impact the descending reentry vehicle, especially if the offense develops a maneuvering reentry vehicle. Based on the work done during my SDI watch, I believe high-endo-atmospheric intercept is feasible for defenses of all basing modes deployed close enough to reach the reentry phase of the attack.

A layered defense including all three phases can frustrate an attacker attempting to maximize the offensive countermeasures for any given phase. For example, boost-phase defenses can destroy a threatening rocket before it can dispense either its warhead/reentry vehicle or associated decoys, making such countermeasures pointless. If the offense spends the effort to develop a higher acceleration booster

to defeat the boost-phase defense, it may pay a weight penalty that reduces the midcourse countermeasures suite, thereby reducing the challenge to a mid-course defense. Furthermore, a terminal, high-endo-atmospheric defense that strips away light decoys and chaff can defeat the midcourse countermeasures. If a maneuvering reentry vehicle is designed to defeat a high endo-atmospheric defense interceptor, the weight penalty will also degrade the midcourse countermeasures suite.

As noted above, an additional consideration is the possibility of directed energy defensive systems, such as lasers, which can be used to shoot down ballistic missiles early in their boost phase. The Airborne Laser is such a system, but because its beam must penetrate the atmosphere along a more or less horizontal path, it must operate within a few hundred miles of the launch area of a potential threat—and this can pose a significant operational and political problem. This problem can be solved if such a directed energy system is based in space.

Based on such considerations, my above-mentioned 1990 review, and my SDI experience, my priorities then were—and still today would be:

1. Boost-Phase Intercept;
2. High-endo-atmospheric intercept in the Terminal Phase; and
3. Midcourse Intercept, if we have an effective algorithm to identify threat reentry vehicles in the face of midcourse countermeasures.

However, I was not then permitted to pursue a program based on these priorities. For example, the most effective boost-phase defenses were not permitted under the ABM Treaty, which prohibited even the development and testing of the most effective basing modes since they could defend the United States—and the purpose of the Treaty was to keep the United States (and the Soviet Union) vulnerable to ballistic missile attack. The only ground-based site that we could deploy was at Grand Forks, ND and Congress directed that I focus on developing and deploying that "Treaty-compliant" site. At best, we could include high-endo-atmospheric terminal defenses to strip away light-weight decoys—and our program included as a follow-on development a combined endo-exo-atmospheric interceptor (E^2I).

Development of sea-based, air-based and mobile land-based defenses had to be limited to a Theater Missile Defense role. The legacy of these constraints lives on today in that sea-based defenses continue to be restricted to a Theater Missile Defense role even though they have an inherent capability against long range ICBMs, as has been shown by numerous theoretical studies and to some degree demonstrated in fact by the recent adaptation of the Aegis Standard Missile to shoot down a satellite, traveling at a higher speed than an ICBM.

Space-based defenses obviously could not be limited to a Theater Missile Defense role—still, space-based sensors were permitted, and needed, to support ground-based defenses. But research and development on space-based interceptors had to be limited to technology demonstrations, for which Congress appropriated $300 million in FY1993—before the Clinton administration killed that program and all associated technology development.

In my opinion, the technology developments for small, very smart space-based interceptors with intercept capabilities in all the above phases of flight provided the best product of the SDI years, and the only one with the prospect of meeting the so-called Nitze criteria, mandated by Congress, that effective defenses should be survivable against direct attack and cost-effective at the margin against offensive countermeasures. These facts might be born in mind when considering the $10 million requested in the President's budget to explore the feasibility of a space test bed in the context of the Committees interest in dealing with offensive countermeasures.

While the Reagan-Bush-41 SDI program actively considered all these technology alternatives within the limits of the ABM Treaty, the Clinton administration sharply curtailed all missile defense programs. All space-based defense work was cancelled, ground-based defenses were reduced by 80-percent (totally killing the E^2I system designed as a follow-on to the exo-atmospheric-only ground-based interceptor). Even the Clinton administration top priority Theater Missile Defense programs were cut back by roughly a quarter. A key loss was the Science and Technology program in which SDI was investing about $1.3 billion a year in 1993 dollars—it was cut to something like $50 million, dead-ending many important activities that were the legacy of the S&T programs derived from DARPA and the services when the SDI program was formed in 1984. To my knowledge, most of these losses have not been restored. The best technologies that resulted from $30 billion invested during the 10-year SDI era were, in my judgment, lost and have had little impact on subsequent missile defense programs, including today's.

For example, the cutting edge light-weight sensors, propulsion, computers, etc. developed to assure a viable cost-effective space-based defense became politically incorrect and to my knowledge have not been pursued for U.S. missile defense applications since 1993. The maturity of these technologies was demonstrated by the 1994 Clementine mission to the Moon, which won national acclaim among the scientific community while space qualifying almost all the technology necessary for a space-based interceptor system. (The National Academy of Science and

NASA presented the Clementine team with awards and a replica hangs today in the Smithsonian.) When Congress sought to continue to exploit this important technology in civil space applications, President Clinton used his momentary line item veto to cancel the follow-on NASA effort, because, according to a White House aid, it used "Star Wars" technology prohibited by the ABM Treaty.

Thus was ended the technology pathway that could have long before now led to light-weight kill vehicles that, for example, would have enabled the Navy's sea-based interceptors to reach substantially higher velocities, providing greater reach to defend much larger areas, including against ICBMs.

Thankfully, President Bush withdrew from the ABM Treaty in 2002, making it possible to revisit the basic lessons, redirect the missile defense programs according to the priorities I suggested above, and reinvigorate the technology base to enable much more capable defenses in both the near and far term. In my view, this has not yet happened. Instead, most resources have been placed against the 1993 scaled-back Clinton Ground-Based Defense program, albeit expanded to include mobile components previously prohibited by the ABM Treaty and with ground-based interceptors sites other than at Grand Forks.

Returning to the basics I have reviewed above would be entirely consistent with the Missile Defense Act of 1999, which passed by an overwhelming majority in Congress, was signed into law by President Clinton in July 1999, and was recently reiterated in the Defense Authorization Act of 2008. It stated:

> *"It is the policy of the United States to deploy as soon as technologically possible an effective National Missile Defense system capable of defending the territory of the United States against limited ballistic missile attack (whether accidental, unauthorized or deliberate)."*

Given this congressionally mandated national policy, countinuing debate should not be about whether to build and sustain an effective defense—rather about how. I believe several things would result from such a return to basics, including:

- A reinvigorated technology development effort to assure viable missile defenses into the future, whether at the Missile Defense Agency, at DARPA or in the services as their respective components of a global defense architecture matures.
- A substantially increased level of funding for sea-based defenses, to fully exploit the inherent flexibility of operating freely in international waters—and to provide defensive options in all three phases of flight. In many ways,

the Navy's sea-based defenses are closest to an operational global defense capability, but they have been limited—arbitrarily I believe—to a Theater Missile Defense role. This was understandable under the constraints of the ABM Treaty, but not any longer.

- A revival of efforts to exploit the obvious benefits of space-based defenses, beginning with the President's proposed space test bed.

Finally, I want to close by emphasizing what I consider to be an urgent and largely under-appreciated threat—the possibility that terrorists could purchase SCUDs or cruise missiles and use them to launch weapons of mass destruction at our coastal cities from ships off our coasts. This is not a new threat, and it could circumvent the major expenditures now being made to prevent the smuggling of weapons of mass destruction into the Untied States from the surrounding maritime pathways.

A near-term response to this threat is to outfit the Aegis ships that normally operate in our ports and along our coasts so that they can shoot down these cruise and ballistic missiles. By the end of this year, the Navy will be operating sixteen such ships in the Pacific and two in the Atlantic. As one who lives along the east coast, I strongly urge Congress to provide the funds to increase the Aegis ballistic missile defense capabilities in the Atlantic—and to fund the extension of the East Coast Test Range to ballistic missile defense testing to help provide a deterrent as well as well as a real defense against this currently existing threat.

To further emphasize the importance of this threat, I call your attention to the report of the congressionally-mandated Commission to Assess the Threat to the United States of Electromagnetic Pulse (EMP) Attack. Terrorists that launch a single SCUD from a ship off our coast and detonate a nuclear warhead 50-100 miles above our densely populated areas could create havoc with enormous political and economic consequences. Such a threat should not be ignored, especially when there are defensive alternatives to counter it.

Thank you, Mr. Chairman, for permitting me to share my views on theses important issues. As should be clear, I am a strong advocate for building, as quickly as is possible, effective global defenses to protect the United States and our overseas troops, friends and allies—and I believe a return to basics will lead to a more cost-effective development of such a capability.