Testimony before the
House Armed Services Subcommittee on Strategic Forces
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March 9, 2017

Introduction

Chairman Rogers, Ranking Member Cooper, and members of the Subcommittee, we thank you for the opportunity to testify today concerning "Nuclear Deterrence – the Defense Science Board's Perspective". We will present and discuss the principal findings and recommendations developed by the Defense Science Board (DSB) over the past ~15 years on topics related to nuclear deterrence. These results are summarized in Chapter 2 of the recently published DSB report "Seven Defense Priorities for the New Administration."

Background on the DSB

First, however, we want to introduce the members of the subcommittee to the DSB, since we understand that some of you may not be familiar with the organization. The Board was established as a Federal Advisory Committee in 1956 as an independent source of scientific and technical advice to the Secretary of Defense and his/her leadership team, both civilian and military.

The Board today consists of 46 members, all of whom give their time pro bono, and devote upwards of 60 days a year. Members include senior executives from defense and commercial industry; retired flag officers; former senior officials from DoD, the State Department, and the Intelligence Community; university professors; and leaders of Federally Funded Research and Development Centers (FFRDCs) and National Laboratories. Many are members of the National Academies of Science, Engineering, and Medicine. Collectively we bring a strong background and interest in science and technology, and deep knowledge of DoD, national security, and the Federal Government so that our recommendations are realistic and can be implemented.

We are tasked by Department leadership in OSD, and occasionally by Congress, with difficult, unstructured problems for which solutions might address high consequence issues or present game changing opportunities. A few examples to illustrate the range of our activities over those 60 years include:

- *"Owning the Night" – achieving night vision*
- *Design of a U.S. Anti-Satellite capability*

- *Concept for Assault Breaker, which led to the Army's Tactical Missile System(ATACMS)*
- *Secretary Directive 3000.05 Military Support for Stability, Security, Transition and Reconstruction Operations*
- *"Submarine of the Future" - the design of fast attack submarines*
- *Electronic Warfare*
- *Strategic Surprise (What are we neglecting in 2014 that we will regret in 2024?)*
- *Autonomy's potential as part of the "third offset"*

We are expected to be persistent on matters we think critical, such as cyber, where we can point to more than a 20-year recognition of vulnerabilities and therefore threats, and evolving recommendations on what to do. Of interest to this subcommittee would be the near continuous attention given to nuclear issues throughout the 60-year history of the board, including a successive string of task forces in the past 15 years during a time, until recently, when nuclear issues assumed a lower profile in national and Department priorities.

The three of us represent more than 100 years of experience in nuclear weapon and broader national security matters. Dr. Anastasio had a 31-year career with DOE's nuclear weapons design laboratories, having served as Director of Lawrence Livermore National Laboratory and following that, as Director of Los Alamos National Laboratory. He is a 5-year member of the DSB and is in his 14th-year supporting the Commander of Strategic Command (STRATCOM) as a STRATCOM Advisory Group (SAG) member and a special advisor. Dr. John spent 28 years associated with nuclear weapons systems engineering at Sandia National Laboratories, retiring as Director of its California Laboratory, and is a 13-year member of the DSB, as well as Vice Chairman of DoD's Threat Reduction Advisory Committee. Both have been recruited and continue to stay involved in nuclear related matters after retiring from their laboratory positions. Dr. LaPlante has worked with nuclear delivery systems since 1985, led the Fleet Ballistic Submarine (SSBN) Security Program at the Johns Hopkins Applied Physics Laboratory, and has been a STRATCOM SAG special advisor for 11 years. Most recently Dr. LaPlante served for approximately three years as the Assistant Secretary of the Air Force for Acquisition where he oversaw nuclear modernization programs such as Ground Based Strategic Deterrent (GBSD) and the B-21 bomber. He too continues to be involved in nuclear related issues as a Vice President of the MITRE Corporation.

<u>The DSB's Perspectives on Nuclear Deterrence</u>

With that as background, we will now focus on the DSB's "Seven Defense Priorities for the New Administration." The purpose of this effort was to present the DSB's perspective on the most pressing national security issues and opportunities to the incoming Administration to help them in making a fast start. While the topics that have been addressed by the DSB span a

wide range, seven major themes dominated the Board's considerations. Today we will discuss the theme relevant to this hearing "Deterring the Use of Nuclear Weapons".

Key Elements of Nuclear Deterrence

There is no more important objective than preventing a nuclear attack on the United States or its allies. The strategy for prevention has rested on deterring an attack by making the cost to the adversary who would dare so high that it outweighs any perceived benefit so that he would never attack in the first place. The realization of that strategy has evolved to three principal elements, which are manifest in the U.S.' nuclear forces, the so-called Triad:

1. Strategic (ongoing) stability: through single warhead intercontinental ballistic missiles; i.e., the adversary would have to commit to a massive, pre-emptive attack on the continental U.S. to negate that capability;
2. Crisis stability and flexibility: through an air delivered force; i.e., bombers and fighters carrying nuclear weapons with a longer execution time than a ballistic missile and which could be deployed worldwide;
3. Assured second strike: through submarine-launched ballistic missiles; i.e., a system difficult to detect and always on patrol.

The DSB believes that the Triad's complementary features remain robust tenets for the design of a future force. Replacing our current, aging force is essential, but not sufficient in the more complex nuclear environment we now face to provide the adaptability or flexibility to confidently hold at risk what adversaries value. In particular, if the threat evolves in ways that favorably change the cost/benefit calculus in the view of an adversary's leadership, then we should be in a position to quickly restore a credible deterrence posture.

While the Triad represents the most visible manifestation of deterrence and is overdue for modernization, there are many other factors that contribute to deterrence and also require attention. Together with the Triad, these factors present to any adversary the credibility that the U.S. is fully capable of executing against our strategy under any circumstance; namely that the U.S. can impose unacceptable costs and/or negate any perceived benefits of an adversary's actions. They include:

- The operational readiness of the force as demonstrated through training and exercises;
- The ability and capacity of the technical enterprise to anticipate and respond to changes in the threat;
- The ability to operate in an adversary generated nuclear environment (referred to as nuclear survivability);
- A robust command and control system;
- Preventing further proliferation – both "vertically" by current nuclear weapons actors, and "horizontally" by new proliferators – through the tools of diplomacy (treaties and

agreements), cooperative and unilateral monitoring, and assurance/extended deterrence to our allies.
- The lynchpin: the demonstrated skills of talented, knowledgeable, committed, and valued people.

The DSB has addressed each of these areas (with the exception of command and control, a topic covered by special commissions) in some depth throughout its history, and especially over the past 15 years as we began to see worrisome trends in the threat..

The Evolving Threat

Despite the "peace dividend" at the end of the Cold War, the DSB remained unconvinced that downplaying the nation's nuclear deterrent would lead other nations to do the same, even as advances in the U.S.' non-nuclear warfighting capabilities proved their effectiveness.
In fact, U.S. conventional dominance demonstrated in Bosnia, Iraq, and Afghanistan, as well as regional imperatives, appears to have catalyzed a greater interest in nuclear weapons by others who do not have the resources to overmatch the U.S. otherwise. The DSB has therefore maintained steady attention on the health of the U.S. nuclear enterprise, Russian and Chinese efforts to advance and modernize their nuclear arsenals, proliferation by other nation states, and advances in technology that could both detect and hide proliferation. The collection of findings point to a worrisome conclusion: the nuclear threshold may be decreasing owing to the stated doctrines and weapons developments of some states, and with introduction of new technology.

The threat from nuclear weapons has grown in ways not experienced during the Cold War. Established nuclear powers modernized and expanded their capabilities in both traditional and non-traditional ways. Both China and Russia began modernizing their strategic forces well ahead of the U.S.' commitment to do the same, while also integrating additional elements such as intermediate range missiles and integrated air defenses, into their force structure. China's nuclear efforts focus on a survivable second-strike force, complemented by non-nuclear capabilities that match or offset U.S. non-nuclear forces and networked operations. In addition to its strategic force modernization, Russia embarked on a steady path since the late 1990s of conventional improvements in precision, stealth, and speed, and development and deployment of theater nuclear weapons with a range of tailored effects in response to U.S. conventional superiority. The Department has seen the relentless pursuit of nuclear capabilities to threaten the homeland by the Democratic People's Republic of Korea, the recently halted march to acquisition by Iran, and the talk of proliferation by some non-nuclear allies and partners who are questioning the U.S.' commitment to extended deterrence and security guarantees. Commerce in the sale or sharing of nuclear materials and weapons design

appeared, and advances in technologies readily accessible even to non-state actors introduce new pathways to acquisition.

Although the threat of nuclear Armageddon has subsided, the nation must still hedge against the existential risk of a massive nuclear exchange, no matter how slim. However, the threats of proliferation, the potential for the U.S. weakening assurance guarantees of its allies, and the emerging scenarios of limited use in regional conflicts or limited strike against the U.S. homeland—with the potential for escalation—introduce complexities not seen since the early days of the Cold War. To address these complexities, U.S. policy has evolved to seek to raise the threshold for nuclear use, at least by the U.S., by relying less on nuclear forces and more on our advanced non-nuclear capabilities, while also committing to modernizing those nuclear force elements deemed critical for deterrence against a massive exchange.

US Nuclear Force and Enterprise Modernization

Nuclear force modernization has been put off far too long. The looming end-of-life of the Triad components and aging production infrastructure is forcing both the DoD and the DOE to commit substantial resources to nuclear modernization. The lead time for obtaining a modernized force is long and the U.S. is starting well behind Russian and Chinese efforts. A balanced program to support the nuclear deterrent force capabilities would consist of three elements: (1) certification and maintenance of current systems; (2) life extension of current systems, and replacement of those systems that can no longer be maintained to the required levels of reliability, safety, and security; and (3) a hedging thrust for responding to future uncertainties. For the first two decades after the end of the Cold War, the U.S. remained unbalanced among the three as attention was paid almost exclusively to sustaining the existing stockpile. Attention to the second element has grown only with the "impossible to ignore" reality in the last few years of end-of-life of critical platforms and warheads. The uptick in priority for nuclear force modernization in both DoD and DOE sends a strong message of U.S. commitment to the deterrent that must continue.

There is still no clearly identifiable set of activities that address the third element, a convincing hedge to future uncertainties, nor has there been since the early 1990s. Already the DoD can anticipate the potential need for capabilities such as a robust nuclear command and control network; hardening or maneuvering for defense penetration; command and control to target to allow command disable in flight should a limited strike scenario not evolve as anticipated; real time battle damage assessment; and embedded weapon system state-of-health monitoring for greater assurance of reliable functioning of a given weapon should a limited use option be necessary. To rapidly field such capabilities would require a production capability utilizing state-of-the-art manufacturing techniques, weapon system architectures, and certification strategies that could support block changes or "plug-and-play" components.

However, there are challenges to overcome to enable a convincing hedge to future uncertainties. A key contributor to nuclear deterrence is the continuous, adaptable exercise of the development, design, and production functions for nuclear weapons in both the DoD and DOE. The DOE principally manages warhead development and production. The DoD's roles are equally critical in setting system requirements, synchronizing the development, production, and adaptation of the delivery platform, and setting the weapon-platform interface requirements. Yet the DOE laboratories and DoD contractor community have done little integrated design and development work outside of life extension for 25 years, let alone concept development that could serve as a hedge to surprise. They are ramping up their efforts to address modernization schedules, but of necessity the new workforce contains a large fraction of inexperienced scientists and especially engineers. And in DOE especially, the ramp up is occurring in facilities well beyond their lifetime and with limited capacity that will stretch schedules to 2040. Plans for facility recapitalization compete with warhead life extension and modernization programs. The last successful construction of a new nuclear component production facility was in 1976. The DoD platform modernization requirements are occurring almost simultaneously with DOE's programs and also extend over two decades, challenged in its case by competing modernization and recapitalization demands for the conventional force.

Nuclear Survivability

If U.S. nuclear forces are to be part of a credible deterrent, they must be able to survive and function in a nuclear environment. A thornier issue is how to maintain our conventional superiority and keep our own nuclear threshold as high as possible in the face of an adversary's limited regional use of his own nuclear weapons. Our critical non-nuclear forces must be able to "fight through" in such a nuclear environment if we seek to rely on those forces as part of our deterrent posture, as has been the desire of successive administrations since the end of the Cold War. In almost all cases in the post Cold War era, however, the attention paid to the topic of nuclear survivability has been limited, in part because of beliefs until recently that theater nuclear use was not a risk, in part because of perceptions that the only recourse is equipment hardening and that the cost to harden is prohibitive, and in part because of the atrophy in the specialized knowledge in nuclear weapons effects and nuclear warfighting principles associated with survivability.

The DSB's persistence on this topic from 2005-2015 ran in parallel and beyond the two phases of the prior Electromagnetic Pulse (EMP) Commission, and resulted not only in a series of reports, but a gradual shift that has started to occur with formal directives and reporting to periodically assess the status of deployed force elements and to ensure that nuclear survivability is addressed in the requirements for major new acquisitions. But

progress will necessarily be slow for developing a new generation of nuclear savvy acquirers, planners, and operators. The DSB has recommended a concerted and systematic approach based on the principle of mission assurance, not equipment hardening, in which:

- Combatant Commands identify mission critical functions derived from operational plans and Military Services then devolve that to mission critical capabilities;
- The analytical community provides support to link mission critical capabilities to specific systems and tactics, techniques, and procedures (TTPs);
- The operational community conducts gaming and experimentation in radiation degraded environments to identify gaps and uncertainties that are subsequently addressed;
- The Military Services ensure a tiered system of education and training in nuclear warfighting, to include a "101" level of knowledge throughout the force and among decision makers;
- The acquisition community sets requirements and the testing and evaluation community conduct assessments tied to mission assurance, not simply hardening levels.
- The technical community is regrown to support all of these activities.

Deterring Acquisition

Another aspect of deterrence has always been limiting the number of nations possessing nuclear weapons (nonproliferation) and for those that do, limiting the numbers and types in their arsenals (arms control). A major DSB effort associated with this area concluded that any progress in treaties and agreements had to take into account the compounding complexities that appear to be aggravating nuclear proliferation concerns into the foreseeable future:

- rogue state actions, such as those of the Democratic People's Republic of Korea, and the potential cascading effects on neighboring allies or partners;
- the impact of advancing technologies relevant to nuclear weapons development;
- the evidence of networks of cooperation among countries that would otherwise have little reason to do so;
- the implications of U.S. policy that relies more heavily on conventional military superiority as a major element of deterrence, accompanied by reductions in numbers of our nuclear weapons;
- the wide range of motivations, capabilities, and approaches that each potential proliferator introduces; i.e., it's no longer just about Russia.

In such a context, the DSB observed that the technical approach for monitoring cannot continue to derive only from treaty and agreement dictates for "point" compliance to the numbers and types formally agreed upon and geographically bounded. Monitoring in this future context must be a continuous process for which persistent surveillance tailored to the

environment of concern is needed. This leads to the need for a paradigm shift in which the boundaries are blurred between monitoring for compliance and monitoring for proliferation, between cooperative and unilateral measures. Monitoring will need to be continuous, adaptive, and frequently tested for its effectiveness against an array of differing, creative and equally adaptive proliferators. In order to create such a comprehensive monitoring framework, three key elements would be needed:

- A systems analytical "white team" able to posit alternative futures, assess current capabilities to detect proliferation, identify gaps and evaluate alternatives;
- New tools to enable proliferation detection as early as possible to achieve persistent monitoring over widespread geographic areas for long periods of time, along with the data analytic capabilities to sift through the massive data sets generated;
- A red-blue field testing capability to elucidate the signatures for proliferation involved with small programs, denial and deception, advanced technologies, etc.

Deeper looks into the early detection problem suggest that there is as yet untapped potential in open source monitoring, making use of state-of-the-art techniques in "big data" analytics for cueing more sophisticated and precise collection resources.

Summary

The level of interest in nuclear weapons has grown with existing nuclear powers, who are modernizing their forces, and in some cases, expanding their capabilities both qualitatively and quantitatively, and with new or latent proliferators. Principal drivers include an affordable hedge against U.S. conventional superiority and a deterrent against regional actors that threaten their interests or sovereignty. In parallel, an aging nuclear force and enterprise to support it in the U.S. has forced the need for a modernization program of our own. The nation, DoD and DOE are stepping up to the commitment needed for modernization (with more focus required to hedging for future uncertainties), but the price to pay in both human resources and budget is substantial, given the more than two decades of neglect. Through its persistence over those decades, the DSB has produced a compendium of findings and recommendations across the spectrum of contributors to deterrence that can provide a rapid head start for the re-learning that must take place.