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Shifting from a nuclear triad to a nuclear dyad

A senior scientist at Lawrence Livermore National Laboratory outlines the rationale for retiring land-based ballistic missiles and leaving a strategic dyad of submarine-launched missiles and air-delivered weapons as the backbone of the U.S. nuclear arsenal.

BY JEFF RICHARDSON

It's decision time. The United States has a small window of time to determine the future of its nuclear weapon capabilities before they atrophy beyond repair or utility. A serious debate is underway in policy circles, the national laboratories, and government about how to reshape and reduce the U.S. capability with an awareness of the chain of events that any decision will initiate. Decisions made in the near future will have national and international security implications for the next 20–50 years. They will affect organizations and treaties (e.g., NATO and START), current and potential nuclear weapon states, and future diplomacy and security options.

If the United States decides to maintain some nuclear weapons capability for the foreseeable future, decisions will have to be made regarding the size and composition of the nuclear weapons complex and force structure. A range of questions will be considered: How much nuclear deterrence is enough? What is the best path to international security? What are the relative benefits of new diplomatic initiatives versus a reconstructed nuclear deterrent? What is the balance between economic globalization and regional interests?

One of the overriding factors will be money. How much is nuclear deterrence worth? There is no giant money bin to fund a one-for-one replacement of the current U.S. stockpile of warheads for ballistic and cruise missiles and bombs, so defense planners will have to carefully consider trade-offs in type and number of weapons in an economically competitive environment. Additionally, the nation simply cannot afford to replace even a substantial fraction

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of the Cold War nuclear complex that was responsible for manufacturing the many parts that go into nuclear weapons, including the fissile materials.

One option explored below would envision the United States moving from a strategic triad of weapon systems—intercontinental ballistic missiles (ICBMs), submarine-launched ballistic missiles (SLBMs), and bombs—to a strategic dyad of SLBMs and bombs. This likely would prove more cost-effective than the current arrangement and would provide latitude for the United States to address threats to national and international security that are less amenable to nuclear deterrence.

The past is not prologue. Cost and the changing nature of threats facing the United States are the two main reasons a strategic dyad could be an attractive option for U.S. war planners. The current U.S. nuclear capability is beset with technical, organizational, operational, and infrastructure challenges that make it increasingly difficult to simply downsize in place; at some point, there is no longer sufficient critical mass to sustain the capability, and the incremental unit cost becomes unsustainable. A new way of doing business needs to evolve.

Technical challenges. Simply replicating the development of the nuclear weapon systems of the 1960s and 1980s will not extend the U.S. nuclear capability forward in time. Many of the materials needed to construct these weapons are no longer available. In some cases this is because more stringent environmental standards are in place; in other cases the market for those materials has vanished, and therefore, both the materials and associated manufacturing processes have been discontinued.

The classic example is the carbon-carbon composites used for the latest reentry vehicles/bodies. The rayon fiber that was the carbon-fiber precursor is no longer available, and the evaluation of domestic and foreign materials has failed to reveal a suitable substitute. The company that originally supplied the coal tar pitch used as the matrix material for the vehicles also has since gone bankrupt. The material was stockpiled, but because it is a natural product, the shelf life is expected to be short. In both cases, if the United States were to build similar vehicles for new weapons, researchers would have to identify new materials, possibly synthesize and qualify them (including flight tests, which would use dwindling flight assets), and then go through lengthy procurement processes. Both the air force and navy have surplus reentry vehicles/bodies (Mk-12As, Mk-21s, Mk-5s) but would have difficulty acquiring more. Hence, one of the tenets of the enhanced U.S.-British collaboration is that if new reentry vehicles are needed, Britain is on its own.

Additionally, any reconstitution of the U.S. stockpile would emphasize enhanced physical security, safety, and use control—collectively termed surety. All of these characteristics are critical in a safe, modern nuclear stockpile. Enhancing surety is complementary to reducing yield and the amount of highly enriched uranium (HEU) or weapon-grade plutonium used in each weapon, both attributes of the failed Reliable Replacement Warhead (RRW) Program. Compared to legacy nuclear weapons, RRWs would have smaller yields and be more reliable (i.e., enhanced margins and reduced uncertainties). The United States would not need large augmentation and reserve stockpiles, as it would have higher confidence in the deployed stockpile. Thus, the total stockpile and inventory of HEU and plutonium would be reduced, consistent with Nuclear Non-Proliferation Treaty goals.

The specific size of the future U.S. infrastructure will ultimately depend on the formulation of U.S. nuclear strategy detailing the requirements that facilities must support. Many defense policy makers and observers argue that the United States needs to maintain a capability conceptually similar to what was in place during the Cold War in order to provide future flexibility.

The corollary to any implementation of an RRW-like program is that lower-yield weapons have to be more accurate to achieve the same probability of destruction, especially in a counterforce scenario. Achieving that enhanced accuracy would be a significant undertaking. Scenarios requiring enhanced accuracy are splendid catalysts for spirited debate; yet all require substantial technical advances and investment.

Organizational challenges. Nuclear policy and planning has disappeared from the organizational chart of the Office of the Secretary of Defense. In the George W. Bush administration it was buried in a policy organization entitled Special Operations/Low-Intensity Conflict, an ironic assignment, under a deputy assistant secretary who had additional non-nuclear responsibilities. It remains to be seen how the Obama administration and the forthcoming Nuclear Posture Review will adjust the relative importance of policy regarding nuclear weapons and WMD in the Defense Department policy and "acquisition, technology, and logistics" hierarchy. As a start, the administration has realigned countering WMD with the office addressing global strategic affairs and dedicated a deputy assistant secretary to the issue in the secretary's policy office.

The recent task force, led by former Defense Secretary James Schlesinger and charged with reviewing the department's management of nuclear weapons, recommended altering the organizational responsibility for nuclear operations in the air force. While previous panels have made similar recommendations, recent incidents involving the handling of nuclear weapons have highlighted for the air force and the nation just how much complacency has set in with respect to the handling of nuclear weapons. However, hurdles internal to service operations remain, and the air force needs to dedicate resources to recalibrate the lines of authority and responsibility over the weapons and institutionalize associated funding priorities. Major decisions have yet to be made with respect to adequately funding the newly defined nuclear mission within the air force for the next 50 years.

Operational challenges. Reliability and performance are cornerstones to a credible nuclear deterrent. As the number of weapons and weapon systems declines, it is even more important to have the utmost confidence in the systems in place. A number of issues confront currently stockpiled nuclear weapons and their associated delivery systems. Many of these issues are fundamentally rooted in the lack of attention and funding devoted to the nuclear mission by the armed services given the additional global security threats. The result of this inattention is that defense policies and programs make locally optimized decisions without consideration for the overall system effect.

One example of this phenomenon was the RRW Program, which was initially proposed to modernize the stockpile, improve reliability, minimize fissile nuclear material, enhance surety, and catalyze a transformation of the nuclear complex. The program, if fully funded and implemented, may have achieved all of these goals. Yet, for RRW to be of a military utility comparable to current weapons, over a range of countervalue and counterforce scenarios, would require a corresponding increase in accuracy to compensate for decreased yields. This additional requirement was never effectively factored into the program's cost.

What's worse, it is easy to envision a strategic environment where the most obvious technology to implement improved accuracy, GPS, would be irrelevant due to enemy actions. Technologically advanced alternatives to GPS guidance are not well-defined, suggesting that improved accuracy would require investment well beyond what was envisioned for RRW.

A second operational example involves missile defense and the potential development of maneuverable reentry vehicles to maintain the U.S. deterrent capability against an adversary's missile defense. (The requirement for such a system stems from an example of worst-case logic: If the United States can intercept an adversary's missile, at some point the adversary may be able to intercept a U.S. missile.) Defense officials have discussed the warhead for such a system but have not scoped out the cost and possibilities for an enhanced reentry vehicle. Given the lack of materials and flight-test assets for replacing current reentry vehicles, this process should precede, or at least run parallel, to warhead concept development in order to determine the system cost. Ignoring the overall system cost distorts the decision process for the warhead.

Infrastructure challenges. The Energy Department is in the midst of planning a transformation of the nuclear weapons complex. After an initial transitional period in which stockpile stewardship was defined as a stopgap measure, Energy is planning a long-term effort to convert its Cold War legacy infrastructure to a smaller, safer, more secure, and less expensive nuclear weapons capability consistent with its role in the new U.S. triad of offensive weapons, defensive weapons, and infrastructure. To avoid projected transformation costs, successive iterations have been downsized to the current transform-in-place paradigm, whose alternatives are presented in the Complex Transformation Supplemental Programmatic Environmental Impact Statement.

The industrial infrastructure that supports the manufacture of ballistic missiles is also facing serious stresses. While it has dismantled all Peacekeeper ICBMs and has put its plans for a future Land-Based Strategic Deterrent on hold, the air force is left with few options besides continuing to refurbish its allotment of Minuteman III missiles.

The specific size of the future U.S. nuclear infrastructure ultimately will depend on the formulation of Washington's nuclear strategy detailing the requirements that facilities must support. Many defense policy makers and observers argue that the United States needs to maintain a capability conceptually similar to what was in place during the Cold War in order to provide future flexibility. Yet, that position would be an expensive luxury in a time of financial crisis, health-care malaise, and an aging populace. Only Russia has a dedicated, redundant nuclear weapons complex comparable to that of the United States. Other nations, such as Britain and China, support their nuclear deterrents with a much smaller, leveraged capability.

Other questions cloud the infrastructure discussion. To consider the possible outsourcing of non-nuclear components and the need for a two-lab system requires agreement on a coherent strategy. Were limited demands placed on the nuclear deterrent, nuclear testing prohibited, and an advanced certification methodology based on Quantification of Margin and Uncertainties implemented, it would be possible to simplify the process of peer-reviewing the work of weapon designers. After all, the Little Boy design was never tested, and Israel is assumed to maintain a robust nuclear deterrent with no proven and attributable tests. As the previous U.S. complex had an effective lifetime of approximately 50 years, now is the time to appropriately size the U.S. nuclear complex for the next 50 years, based on a rational expectation of need rather than a desire to maintain some capability as a hedge against future uncertainty.

There would be significant operational advantages to maintaining a portion of the U.S. nuclear capacity to be delivered via aircraft. Only air delivery provides the option to recall weapons once orders are given to deploy nuclear assets. Also, because air delivery requires aircraft to have a high likelihood of penetrating enemy airspace, possible attack scenarios would be limited, while the option would provide visible and credible dissuasion attributes.

Yet the development time for a new bomber is long, and the expense is large. It takes decades to develop a new manned military aircraft. For example, the development of the Joint Strike Fighter began in the mid-1990s with an initial price tag of about $100 million per plane. Today, the first production unit has yet to be delivered, and full production isn't expected until 2013. Recent projections suggest the air force's next-generation bomber won't be fielded until 2018 at the earliest, and the effort is on hold pending a better requirements definition. Even worse, there is no discussion of a cruise missile follow-on to the Air-Launched Cruise Missile, whose service life, like that of the B-52 bomber and Minuteman III ICBM, is being continually extended. (Ironically, the newer Advanced Cruise Missile has already been retired.) And a number of details continue to vex weapons experts, for example, adapting the analog communication-and-control systems of the entire stockpile of air-delivered nuclear weapons to be compatible with air platforms equipped with digital systems. Despite these challenges, future air-delivery capability can leverage its relationship with and knowledge of the commercial aircraft industry. It is not solely a Defense-oriented industry, nor will it have to be recreated from scratch in the future.

The industrial infrastructure that supports the manufacture of ballistic missiles also is facing serious stresses. While it has dismantled all Peacekeeper ICBMs and has put its plans for a future Land-Based Strategic Deterrent on hold, the air force is left with few options besides continuing to refurbish its allotment of Minuteman III missiles. After its refurbishments and life extensions, the missiles are expected to be in service through 2030. The navy also is concluding trickle production of the Trident D5 SLBM and will maintain the D5 well past 2030. At least the navy is beginning plans for the D5 successor, aptly named the Sea-Based Strategic Deterrent (not without conscious irony), but that is not expected to be in service until 2040 at the earliest.

The conundrum facing the United States is how to maintain—and at what funding, technology, and capability level—the manufacturing infrastructure and expertise associated with ballistic missiles until it reaches the next missile crisis 20 years from now.

A potential end state. In making future plans, the planning process is frequently more valuable than the plan that results from it. The current debate about what form the U.S. nuclear arsenal should assume revolves around a mix of conflicting policy objectives and diverse technology pathways that all are constrained by inadequate funding. Congress has requested a comprehensive strategy instead of making tactical decisions in a piecemeal fashion, thus the forthcoming posture review and Quadrennial Defense Review. But rather than continuing to sit at 90,000 feet and debate the merits of all or nothing, it would seem most productive for policy makers and military planners to suggest alternate pathways forward and debate which track will lead to technologically achievable and fungible end states. In my view, all parties should recognize that the end state of nuclear warheads and their associated delivery systems should mitigate possible risk and provide a hedge against potential scenarios, but also acknowledge that the elimination of all risk is unachievable.

Yes, the United States has to guard against a potential breakout capability or technological surprise, but a newly configured weapons complex that manufactures weapons in the absence of concrete requirements is not a fiscally prudent insurance policy.

Barring an unforeseen technical surprise, SLBMs always have been the most robust of the triad legs. Let them remain so. The United States has embarked on a W76 life-extension program, which it claims will extend the warhead's usable lifetime by 20–30 years. The extended life of the W76 coincides with expected lifetimes of the Ohio-class submarines and the life-extended Trident D5s. The W76 life extension work does not require a new plutonium pit production facility, and the navy has a substantial, dedicated, largely effective infrastructure to manage the operation of its fleet of missiles, including service facilities, dedicated career paths, and a test program. On the flip side of the equation, the baseline infrastructure to maintain Ohio-class submarines at sea is considerable and costly, so several boats need to be deployed in order for the operation to be cost-effective. U.S. officials will have to develop additional options as the lifetimes of current systems and weapons are reached. For instance, the W88 warhead could be allowed to fail gracefully, much like the land-attack cruise missile. In the meantime, the SLBM fleet remains the most cost-effective countervalue deterrent, broader and more capable but similar in scope to the British deterrent. The reasons to maintain both are similar.

Earlier, I mentioned several of the policy reasons to maintain an air-delivered nuclear capability: They can be forward based (e.g., NATO support), hence visible manifestation of the extended nuclear umbrella; they are subject to recall; they focus attention; and they rely on pre-established air superiority for successful penetration. In addition, these delivery platforms can be dual-use capable, avoiding the necessity of a dedicated, nuclear-only service infrastructure. The number of weapons in this leg of the triad is modest, and they are not meant to deter Russia or China. Consequently, various proposed reuse options to extend the lifetime of current stockpile bombs are viable, without extensive infrastructure modernization. A "surety-enhanced," life-extended option for the B61 family of bombs would maintain this nuclear capability for several decades, which would be suitable for use against potential emerging or asymmetric threats.

There are fewer compelling reasons to argue for the maintenance of the third triad leg, the ICBMs. The main reasons to discontinue it are age and cost. The basic Minuteman ICBM infrastructure dates back to the 1960s, although it has been continuously upgraded, most recently with respect to physical security. The Minuteman III is on its last major life extension with dwindling test resources and no visible support or infrastructure to begin the necessary planning for a complete replacement. Some ICBM warheads would have to be refurbished to remain in service, a prospect made even more daunting with limited facilities and competition with the W76. Improved surety, which is most important for ICBMs, would require upgraded accuracy. The ICBMs' most salient national security benefit is an overwhelming, prompt response, a tangible but dwindling risk-mitigation argument.

Should this strategic alignment be adopted, the rate at which the current stockpile is reduced should be determined in part by systems' natural lifetimes, reliability assessments, and the availability of test assets. The SLBM drawdown could be particularly slow, subject to international negotiations and verification, as there are no apparent, strong technical drivers over the next couple of decades. A total stockpile on the order of 500 warheads would satisfy the principle objectives of strategic nuclear deterrence in "rational" scenarios where strategic deterrence is a useful concept. This size stockpile would pose the threat of certain destruction in the event of an escalating exchange, and it would provide a flexible response and the potential for incremental use in cases of extreme military or political necessity. It would be credible in both the continental United States and forward-deployed scenarios, minimize risk, provide an enhanced-surety deterrent, and be sustained with a reduced complex. It would avoid extending the lifetimes of warheads for delivery systems that are approaching the end of their life. It would avoid rebuilding nearly from scratch an ICBM replacement infrastructure with a limited product build. With more robust warheads in service, it would allow the nondeployed stockpile to be reduced. And it would distribute the deterrent across the two most useful delivery systems.

With a small arsenal, force structure is more important than the absolute number of warheads. The world is an uncertain place, but some level of nuclear deterrence provides an "essential insurance against the uncertainties and risks of the future," according to *The Future of the United Kingdom's Nuclear Deterrent*, a publication of the Defence and Foreign ministries.

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Answering objections. The end state described above will provoke debate from certain camps, most notably, the pro-nuclear camp that feels unconstrained by fiscal resources and strives for a risk-free world. The following might be reasonable responses to these potential objections.

In response to those who suggest that a low level of nuclear forces invites Russian superiority and Chinese parity, I would argue that reducing its force levels in the manner described above would provide the United States with the opportunity to lead by example, while not significantly sacrificing national security. In the final analysis, both Russia and China will do what is best for them, and U.S. actions are only part of the equation. The negotiation of a START follow-on agreement is a positive step in this regard. I would add that Russia and China have coexisted for decades along a contentious border with a large mismatch in conventional and nuclear forces. From this scenario, strategists have learned that it is most important to have a sufficient deterrent rather than an equal deterrent. China, France, and Britain all have, from their viewpoint, sufficient nuclear deterrence.

Others will argue that reusing existing stockpile components would undermine the transformation of the complex and the infrastructure leg of the new triad. Yet, in the absence of strong military or policy requirements, and in a climate of stockpile reduction, it is hard to justify large expenditures for an industry leaning toward obsolescence. Yes, the United States has to guard against a potential breakout capability or technological surprise, but a newly configured weapons complex that manufactures weapons in the absence of concrete requirements is not a fiscally prudent insurance policy.

The national laboratory system, if properly sustained, provides the first bulwark against technological surprise. The second is trickle production. To maintain no manufacturing capability is to invite disaster, as understanding does not equal capability. Trickle production can also ensure the existence of a domestic manufacturing capability by diversifying the U.S. production base to include commercial suppliers for non-nuclear components. Coupled with a total stockpile (deployed plus reserve) of well less than

1,000 warheads, a trickle production capability centered at the national laboratories and involving the private sector will provide a sustainable strategy for the future. ■

Jeff Richardson has been on the Lawrence Livermore National Laboratory staff for 35 years. He has worked on nuclear weapons programs and the nuclear-pumped X-ray laser and was a division leader for chemistry and then nonproliferation activities. He recently completed a two-year assignment with the air force in the Pentagon, where he worked on reliable replacement warhead activities and enhanced U.S.–British collaborations. A summary of the latter work, "A New Partner in Enhanced Collaboration: The U.S. Air Force," was included in the recent Center for Strategic and International Studies book, U.S.-U.K. Nuclear Cooperation after 50 Years. *The views expressed herein are those of the author and do not represent the official position of Livermore, the Energy Department, the U.S. Air Force, or the Defense Department.*

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