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Mailing Address:
Director, U.S. Army Nuclear and Countering WMD Agency (USANCA)
5915 16th Street Bldg 238
Fort Belvoir, VA 22060-5514

Telephone: 703-806-7854,
DSN 656-7854, Fax 703-806-7900

Inside the Journal

DIRECTOR NOTES

Mr. Daniel M. Klippstein
Director, USANCA
Deputy Director of Army Strategy, Plans and Policy Directorate, HQDA

I want to thank the National Defense University's Center for the Study of Weapons of Mass Destruction for contributing the works in this special edition of the *CWMD Journal*, focusing on the nuclear enterprise. As a member of the Nuclear Weapons Council Standing and Safety Committee, I am involved in the modernization of nuclear weapons and a range of stockpile management decisions that ensure we maintain a safe, secure, and reliable deterrent capability.

With the end of the Cold War, our expectations were that our nuclear challenges would soon be a problem of the past. However, persistent efforts by the Democratic People's Republic of Korea to continue to develop a nuclear weapons program, and a resurgent Russian Federation striving to re-gain its super power status by in part modernizing its nuclear capabilities, are just two recent examples of why nuclear weapons still remain one of the greatest threats facing the United States and her allies. Additionally, the threat of intentional nuclear proliferation and possible loss of control of nuclear materials present significant challenges to countering weapons of mass destruction mission efforts.

These seven essays all come from recent graduates of the Countering Weapons of Mass Destruction Graduate Fellowship Program, which awards a Master of Science Degree from Missouri State University in cooperation with the Center for the Study of Weapons of Mass Destruction at National Defense University. I am a huge advocate of this Fellowship Program; in fact, two of my employees at USANCA are current students. The quality of the scholarly achievement of the students in this program can be seen in each of the essays presented in this special edition. I strongly encourage any CWMD professional residing in the greater Washington D.C. metro area who is seeking a graduate education or professional development opportunity to apply for acceptance into this program.

I am confident that reading this special edition issue of the *CWMD Journal* will increase the level of dialogue on not only nuclear issues but also that of the broader CWMD threat.

Please visit http://www.hdiac.org/ to find previous editions of USANCA's *CWMD Journal*. As professionals committed to countering WMD threats, I would ask that you continue to submit high quality articles for publication in our semiannual editions. The more we assess and write about this continuing threat, the more we contribute to the overall body of knowledge and the better served we all are to handle the complex and complicated challenges associated with countering the use and proliferation of weapons of mass destruction.

LOOKING AHEAD AS WE MUST: U.S. NUCLEAR WEAPONS AND THE FUTURE

Dr. John Mark Mattox, Guest Editor
National Defense University

No rational, moral, or other kind of imperative exists to the effect that one must like nuclear weapons. It is even less imperative that one like the implications of their existence. However, imperative or not, nuclear weapons have been with us for seventy years, and no reason exists to suppose that they will not be with us for another seventy years—or longer.

Over the past seven decades, the record with respect to nuclear weapons has been mixed:

- Some states have succeeded at eliminating their nuclear arsenals (i.e., Belarus, Kazakhstan, South Africa, and Ukraine).
- Some states have succeeded at terminating their nuclear weapons research programs (or at least at putting them on hold in a way that allows these states to declare success to that end), i.e. Argentina, Australia, Brazil, Egypt, Indonesia, Iraq, Italy, Libya, Norway, Romania, South Korea, Sweden, Switzerland, Taiwan, and Yugoslavia—albeit arguably on the basis of a variety of motivations.
- Some may not have deemed nuclear weapons development to be worth the trouble (Australia and Switzerland).
- Others may have been heavily dis-incentivized (Iraq and Libya).
- Others may have felt themselves safely ensconced under a collective security arrangement (Italy and Norway).
- Still others may have determined the U.S. nuclear security umbrella, whether promised or implied, to be adequate for the present (South Korea and Taiwan).
- Some states have developed nuclear weapons apparently as a direct challenge to the United States (USSR/Russia, China, and North Korea).
- One allied state has moved largely in tandem with the United States with respect to nuclear matters (United Kingdom).
- Another state, although allied with the United States, struck out on its own nuclear development after wondering aloud about the dependability of U.S. nuclear security guarantees (France).
- Another U.S. ally has said—well, it really hasn't said what it is doing (Israel).
- Still other states appear to have obtained nuclear weapons primarily in response to regional security concerns (India and Pakistan).
- Another state (Iran) is or is not pursuing nuclear weapons, depending on whom you ask.
- Moreover, one is loath to imagine that there exists no terrorist or other non-state organization, which, given the opportunity, would not develop, beg, borrow, or steal nuclear weapons.

Should the world free itself of nuclear weapons? A response in the affirmative is, in fact, the current policy of the United States Government. Is that a good policy? If the absence of nuclear weapons is good, then it is, by definition, a good policy. Even Winston Churchill, who memorably pled before the U.S. Congress in 1952, "be careful above all things not to let go of the atomic weapon until you are sure, and more than sure, that other means of preserving peace are in your hands,"[1] would probably agree. Given the right conditions, not even Winston Churchill advocated having nuclear weapons merely for the sake of hanging on to them. Indeed, good and prudent reasons exist for modern militaries having already let go of sticks and stones or bows and arrows. However, the security environment must be one in which to let go and not hang on makes sense. That applies to nuclear weapons and to every other kind of armament. It is precisely for this reason that the current policy of the United States Government is to hang on to them for the foreseeable future, and perhaps beyond.

But what exactly does "hanging on" to nuclear weapons actually look like? In particular, what does hanging on mean as it pertains to an arsenal whose age is increasing interminably, whose credibility must be maintained, and whose fundamental *raison d'etre* appears not to be going away? This special edition of the *CWMD Journal* represents a thoughtful attempt to engage these kinds of questions.

We begin with Brian Mathias' appraisal of the current developmental trajectory of the U.S. nuclear arsenal, set against the backdrop of nuclear weapons developments in Russia, China, North Korea, and Iran.

John Schmitt and Joseph Burke each then imagine the challenges the U.S. nuclear arsenal and support enterprise may expect to encounter, and certainly will be required to address, in the decades after 2021, when New START expires.

The expiration of New START may be expected to raise, as previous nuclear arms control plateaus have raised, the question of whether the United States should undertake unilateral nuclear reductions. On this account, Donald Parman undertakes a frank appraisal of the perils associated with unilateral nuclear reductions by the United States. These perils, he observes, are part and parcel of the best military advice that policy makers might rightfully expect from defense practitioners. Moreover, the principles that undergird his discussion are applicable to unilateral arms reductions of all kinds.

Craig Roblyer provides a critical appraisal of possible options for modernizing —and, more to the point, consolidating—the nuclear command and control apparatus. Given the earth-sweeping changes in telecommunications in recent decades, his discussion of how the United States might restructure nuclear command and control is both timely and urgent.

George Nunez opens the door to a consideration of the possible correspondences between the theory of deterrence as it has historically been applied to nuclear weapons and as it may or may not prove to be applicable

to the present and emerging cyber threat. He argues that the lessons of the past seventy years of the nuclear era are not without important correlates as pertaining to cyberspace; and if so, that now is the time for security practitioners to capitalize on those lessons.

Finally, William Dobbins asks the hard question that far too many persons charged with national security simply set aside uncritically: On what moral grounds does one justify the employment of nuclear weapons? Dobbins argues neither for the goodness or badness, the rightness or wrongness, of nuclear weapons employment. Rather, he merely asks, in effect, If one were to find a rationally satisfactory moral justification for employing a nuclear weapon, what would that justification look like? His answer is thoughtful, and its ramifications deserve thoughtful reflection by all members of the U.S. nuclear enterprise.

Each of these authors is a recent graduate of the Countering Weapons of Mass Destruction Graduate Fellowship Program, and each, as the result of successful completion of this extremely rigorous academic program, has received the Master of Science Degree in Weapons of Mass Destruction Studies, awarded by Missouri State University in cooperation with the Center for the Study of Weapons of Mass Destruction at National Defense University, Washington, D.C. The views expressed in each of these scholarly essays are those of the respective authors and do not constitute official pronouncement by any U.S. Government entity. Nevertheless, each essay invites the thoughtful reader to reflect upon the nuclear present while looking toward the nuclear future toward which, for better or worse, all of us are inexorably headed. More importantly, each invites thoughtful reflection upon what might be done today to shape that future.

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BIOGRAPHY

John Mark Mattox (Colonel, Ret., U.S. Army) is the Director of the Countering Weapons of Mass Destruction Graduate Fellowship Program at the National Defense University Center for the Study of Weapons of Mass Destruction, Washington, DC. He holds a Ph.D. in philosophy and semiotic studies from Indiana University.
john.mark.mattox@gc.ndu.edu

For additional information on the CWMD Graduate Fellowship Program, see the inside back cover of this journal. Detailed program information is available at https://cwmdgradfellowship.dodlive.mil/.

A TRAJECTORY FOR THE U.S. NUCLEAR ENTERPRISE TO MEET EMERGING NUCLEAR SECURITY CHALLENGES

Brian Mathias
Air Force Life Cycle Management Center

INTRODUCTION

In November of 2014, then Secretary of Defense Chuck Hagel delivered a message to the Department of Defense (DoD) stating, "Our nuclear deterrent plays a critical role in assuring U.S. national security, and it is DoD's highest priority mission. No other capability we have is more important. Our nuclear forces stand alone in being able to deter nuclear attack on the United States and our allies."[1] In spite of this imperative, however, the U.S. nuclear enterprise continues to depend upon aging Cold War-era weapons, a nuclear infrastructure that has not kept pace with technology, and a policy aimed at maintenance of the status quo, as opposed to modernization in the sense of developing new weapon systems reflective of 21st-century technological realities. Moreover, with the passage of time, such modernization as the U.S contemplates becomes increasingly difficult. A study by the Stimson Center estimated it would cost at least $352 billion over the next decade to operate and modernize America's current nuclear arsenal.[2] According to the Pentagon, the U.S. will need to spend $18 billion per year for 15 years starting in 2021 to keep the nation's nuclear stockpile and the weapons and vehicles designed to deliver these weapons viable[3]—that is to say, to maintain a nuclear capability based on decades-old technologies. The trajectory thus charted differs significantly from the trajectories currently being pursued by the U.S.' most likely nuclear adversaries.

RUSSIA

Despite fiscal constraints, Vladimir Putin has made Russia's nuclear force a top priority. Russia is in the middle of a significant nuclear modernization as it attempts to transition from a Cold War-era nuclear force structure to a more modern, leaner, and cheaper to maintain nuclear force. To a significant extent, Putin seeks to compensate for Russia's inferior conventional forces while promoting its nuclear force as a symbol of national prestige. Of concern, however, is Russia's apparent position that a strong nuclear force provides an adequate deterrent counter to a much stronger U.S. conventional military.[4]

Recent events have increased tensions between Russia and other nations. Following the crisis in Ukraine, Washington suspended several projects in April 2014 relating to cooperation on peaceful uses of nuclear energy between the U.S. and Russia. Later in 2014 Moscow announced it would no longer accept U.S. assistance to secure stockpiles of nuclear material on Russian territory, effectively terminating what remained of the Nunn-Lugar program.[5]

Retirement of all Soviet-era Intercontinental Ballistic Missiles (ICBMs) and Sea-Launched Ballistic Missiles (SLBMs) is expected to be completed over the next decade. These systems will be replaced with newer versions of the Russian ICBM and SLBM on a fleet of eight new Borei-class Ship Submersible Ballistic Nuclear (SSBNs).[6] The Russian bomber force is undergoing a variety of upgrades to extend its service life and expand capabilities until a new bomber is ready to enter service. A new nuclear cruise missile, known as the KH-102 air-launched cruise missile, may possibly become operational soon. The Su-34 Fullback fighter-bomber is gradually replacing the aging Su-24M Fencer in the tactical nuclear strike role. The Russian Severodvinsk-class, or Yasen-class, Nuclear-powered, Guided-missile Attack Submarine (SSGN) is nearing operational status, equipped with the new long-range Kalibr cruise missile that may have nuclear capability.[7] Russia's overall defense budget has increased. Over the next 10 years, the Russians plan is to spend $542 billion on defense. Of that amount, strategic nuclear forces are estimated to account for about 10 percent. In 2011, Russian news media and analysts reported that Russia planned to spend $70 billion on new strategic weapons through 2018. Although less than U.S. defense spending, Russian commitment to its nuclear strategy is clear.[8]

CHINA

According to the Nuclear Threat Initiative (NTI), China possesses nuclear weapons and a range of ballistic missile capabilities. China has approximately 260 nuclear warheads and is believed to be increasing their stockpile. China's secretive nature creates considerable challenges for intelligence gathering purposes related to its nuclear weapons. The U.S. DoD asserts that China has approximately 50-60 nuclear-capable ICBMs and four operational JIN-class SSBNs with one more under construction. The SSBNs will carry the JL-2 SLBM.[9]

China joined the International Atomic Energy Agency (IAEA) in 1984, but supplied nuclear technology and reactors to several countries of proliferation concern in the 1980s and early 1990s. China is also understood to have provided Pakistan with nuclear design information and fissile material. The information and material later ended up in the possession of Libya.[10]

China is the first nuclear weapon state to adopt a nuclear no first use (NFU) policy. China has also pledged not to use nuclear weapons against non-nuclear weapon states. China acceded to the Treaty on the Non-Proliferation of Nuclear Weapons in 1992 as a nuclear weapon state and has since improved its export controls, including the promulgation of regulations on nuclear materials and nuclear dual-use exports, and has pledged to halt exports of nuclear technology to un-safeguarded facilities. China's current nuclear posture focuses on survivability and maintaining a second-strike capability.[11]

NORTH KOREA

According to the NTI, the Democratic People's Republic of Korea (DPRK) has an active nuclear weapons program and tested nuclear explosive devices in 2006, 2009, 2013, and 2016. North Korea is capable of enriching uranium and producing weapons-grade plutonium. North Korea deploys short- and medium-range ballistic missiles and successfully launched a long-range rocket in 2012 and 2016.[12]

The Six-Party Talks between North Korea, South Korea, Japan, China, Russia, and the United States began in 2003 with the goal of denuclearizing the Korean Peninsula. However, these talks have been suspended since 2009. In 2012, Pyongyang agreed to suspend nuclear tests, uranium enrichment, and long-range missile tests in exchange for food aid from the U.S. After a dispute with the United States over the launch of a rocket later in 2012, North Korea declared the agreement void, and later conducted a nuclear test in 2013.[13]

The North Korean nuclear enterprise is still in relative infancy, and the full capabilities are unknown. According to Hans M. Kristensen in 2014, "Potential nuclear-capable delivery systems include the Scud C and Nodong short-range missiles, the Musudan medium-range missile, and the Hwasong-13 and Taepo Dong long-range missiles. The KH-08 and Musudan have yet to be test-flown; the Taepo Dong has been successfully flown only as a space launch vehicle. After four nuclear explosive tests, there is no authoritative public information that North Korea has yet test-flown a re-entry vehicle intended to deliver a nuclear warhead."[14] However, accomplishing this task clearly fits with North Korea's established trajectory for nuclear weapons development.

IRAN

According to the NTI, Iran has been a non-nuclear weapon state party to the Nuclear Nonproliferation Treaty (NPT) since 1970, and declares their nuclear program is for peaceful purposes. Nevertheless, its nuclear program has progressed significantly in the past decade with Iran announcing in 2006 that it would begin enriching uranium. Failure to report significant parts of its program to the International Atomic Energy Agency (IAEA), and insistence on developing all aspects of the nuclear fuel cycle, has led many to worry that Iran's true intention is to acquire nuclear weapons, resulting initially in Iran receiving international pressure and sanctions.[15]

THE STATE OF THE U.S. ARSENAL

In spite of these upward developmental trends, the U.S. developmental trajectory continues more down than up. To begin, the age of U.S. nuclear weapon systems poses an enormous challenge, as the potential for systems to break down or fail to respond as intended increases with age in nuclear weapons just as it does with any other device. Corrupted systems, defective electronics, or performance degradation due to long-term storage are symptoms of the larger aging

problem.[16] The median ages of the current systems of the nuclear triad are:

- 18 years for the B-2
- 25 years for the Trident II D-5 SLBM
- 34 years for the Ohio Class SSBNs.
- 45 years for the Minuteman (MM) III, and
- 54 years for the B-52H[17]

Many of the original manufacturers are no longer in business or materials needed to replacing failing components are no longer available. Moreover, remanufacturing weapon parts can be difficult and expensive.

The U.S. planned to replace the aging B-52's with a new bomber in 2018. This bomber would likely serve as a bridge between the current fleet of bombers and what the government expected to be a future unmanned bomber sometime near 2040. Funding constraints and nuclear arms debates have delayed a contract award until recently. While work is being executed to unveil a new strategic bomber or long-range strike bomber in late 2020 the aforementioned hurdles remain a concern. With a replacement for the B-52 possibly a decade away defense strategy must focus time and money on both maintaining and replacing the B-52. Currently, the future of the strategic bomber is not on a trajectory that exhibits high confidence of a bomber in the U.S. nuclear enterprise. The B-52 will eventually become unusable—incapable of modernization. Bombers are critical to the future U.S. nuclear enterprise and keeping pace with advancements of other nuclear powers.[18]

In a 2014 study on the future of the U.S. ICBM force the RAND Corporation concluded the following: The Air Force successfully demonstrated its ability to extend the service life of the Minuteman (MM) III at low cost and low program risk through service Life Extension Programs (sLEPs). sLEPs may have to also be considered for supporting systems, such as silo refurbishment and communications. Sustaining MM III and gradual upgrades is a relatively inexpensive way to retain current ICBM capabilities. Any all-new ICBM system will likely cost almost twice (and perhaps even three times) as much as incremental modernization and sustainment of the MM III system. Therefore, any argument for developing a wholly new alternative is either increased capability or changed threat. Nevertheless, sLEPs, whether for ICBMs or for any other system, are ultimately temporary measures at best. Indeed, an enormous hurdle currently standing in the way of continued sLEPs beyond 2030 is the declining number of missile bodies due to required test launches.[19]

Long-term replacement plans exist for the Ohio-class SSBN nuclear submarine. However, the high cost to procure and sustain leave doubt as to the future of the program. The U.S. has a technological advance over most adversaries with the SLBM leg of the triad. SLBMs are unique in ability and capable of addressing advancing technological capabilities of adversaries, such as aircraft detection and intelligence alerts that would occur during a U.S. bomber launch. Reduced flight time of SLBMs due to a closer launch proximity to target and long-term

underwater capabilities compliment the weaknesses of the other two legs of the nuclear triad. Hence, the degradation or loss of the SLBM leg of the triad would mean a corresponding degradation or loss of these capabilities.[20]

BEYOND THE TRIAD

Currently, no new nuclear weapons are being developed. Moreover, the capacity to build new nuclear weapons, should the need to do so arise, is not obviously present. The infrastructure of the national laboratories themselves may not be adequate to support a new design project, even though they still support nuclear systems by performing modeling, simulation, and validation. Whether these ongoing tasks can translate readily into full-up new weapon development, should the need arise, is not intuitively clear.[21]

The ability of the U.S. to maintain and attract a high-quality workforce, specific to supporting the nuclear enterprise, is critical to assuring the future of the U.S. nuclear deterrent. In spite of the U.S.' technological advantage over its competitors, any human capital advantage eventually atrophies unless it is maintained and postured for improvement over time. Nevertheless, few current scientists or engineers at the National Nuclear Security Administration (NNSA) have nuclear weapons design or testing experience.[22] Between 2013 and 2014, the NNSA lost 94 personnel, leaving only 2,446 employed as of March 2014; and the average age of the workforce increased to 47.7 years.[23] Across the nuclear enterprise, engineers, and weapons designers are approaching retirement in large numbers; and, without testing, an experiential laboratory for passing their skills and field craft to a new generation of nuclear specialists is gone. Maintaining a deep bench of technical expertise is not simply an essential ingredient for solving engineering problems; it is also a clear manifestation of the nation's commitment to nuclear deterrence as potential adversaries compare policy pronouncements with actual funding and manning levels.

In addition to the weapons themselves, there must exist the capacity to produce the thousands of highly specific components that enable the weapon to function. Manufacturing non-nuclear components can be extremely challenging either because some materials may no longer exist or because manufacturing processes have been forgotten and must be retrieved. Beside all of this, there is a certain element of art required during the design of a nuclear weapon. Such skills can be acquired and maintained only through actual hands-on experience and continuous training.[24]

The physical plant of the nuclear enterprise is also at risk: As facilities continue underfunded, the U.S. loses the ability to conduct high-quality experiments that contribute to modernization and technology advancements. Obsolete facilities coupled with poor working environments make maintaining a safe, secure, reliable, and militarily effective nuclear stockpile exceedingly difficult, in addition to demoralizing the current workforce. Limitations due to facility capabilities also hamper efforts to recruit highly-skilled scientists.[25] Addressing the aging

workforce is key to a nuclear enterprise capable of future nuclear challenges because the enterprise will not function without investments in human capital.

Maintaining troop morale without the focus afforded by the shadow of the Cold War is an enormously challenging problem. Beginning in 2015, officers manning nuclear launch control centers received an additional $300 per month in incentive pay. Airmen in certain enlisted fields throughout the nuclear enterprise received up to $300 in monthly special duty assignment pay. While pay increases may temporarily address low morale, they are no panacea.[26] For example, over the recent past, the media has reported scandals such as widespread cheating on nuclear launch tests. Recognizing this complex of human capital concerns, former Secretary of Defense Hagel said, “We must restore the prestige that attracted the brightest minds of the Cold War era, they will no longer be outranked by their non-nuclear counterparts.”[27]

Over the last five years, significant steps have been taken in the DoD to reduce spending across the board. While the U.S. Air Force and U.S. Navy have planned to replace each leg of the nuclear triad, fiscal constraints and policy shifts have continued to delay any such plan. Existing ICBMs and SLBMs are expected to remain in service sometime until the 2030’s and 2040’s, respectively, as modernization efforts have narrowly maintained the capabilities threshold of the aging systems. Whether the current timetable for acquisition of a new bomber can be maintained is yet to be seen.[28]

LOOKING AHEAD

Measures adding more funding to the nuclear enterprise for the short term do not, in and of themselves, put the U.S. nuclear enterprise squarely on a trajectory that addresses long- term funding requirements to maintain delivery systems, human capital, and a credible deterrent. The stability of policy and funding for the future can be very difficult to predict, especially as administrations change. Beyond the matter of funding, however, is the imperative to chart a clear course for the nuclear enterprise so that it will be prepared to meet future needs, not merely present ones, and certainly not past ones. In the absence of a clearly charted course, funds presently allocated to maintain the U.S. nuclear capability may not be expended in the most efficient manner possible. Indeed, it may be the case that the current U.S. nuclear arsenal can strike the entire target set it wishes to hold at risk. It may be that the U.S. can be confident of a second-strike capability as required. However, even granting these hopeful assessments does not negate the reality that billions of dollars will be required, and even under terms of the most carefully executed budget plan, to maintain—even if not modernize—the current nuclear arsenal. Acquisition policies and the laws that govern them impose an additional challenge: even if every cent required to assure the long-term health of the nuclear arsenal were available today, no significant change in the present state of affairs could be effected overnight; and even the simplest tools made to nuclear-certified specifications could take months to acquire. Systemic changes would take years. “Over the next five years,” said Secretary Hagel, “we’re probably looking at a 10 percent increase

in the nuclear enterprise over each of those years. “Right now we spend about $15 to $16 billion on the U.S. nuclear enterprise.”[29] At about $1.5 billion a year, that works out to at least $7.5 billion over five years to improve maintenance at missile silos with doors that investigators found could not fully close, upgrade weapons storage, replace outdated Huey helicopters used for Air Force nuclear base security and to hire thousands more personnel at Navy shipyards.[30] Still, the U.S. nuclear enterprise faces the possibility of a return to sequestration that could completely disrupt the current trajectory for a nuclear force renovation.[31]

These fiscal realities are vastly complicated by calls to lawmakers for the elimination of nuclear weapons. The so-called “Global Zero Action Plan” calls for the United States and Russia— which together hold more than 90% of the world’s nuclear weapons—to negotiate deep cuts in their arsenals, followed by international negotiations to eliminate all nuclear weapons by 2030.[32] Nevertheless, as argued above, the U.S.’ most likely nuclear adversaries are upgrading—not reducing—their nuclear capabilities. On this account, the calculus becomes still more complicated. In an attempt to keep pace, states not currently pursuing nuclear advancement could begin doing so and states that might otherwise seek a rationale to divest themselves of nuclear weapons might feel themselves forced to reconsider. Even U.S.–Russian bilateral reductions leading to zero nuclear weapons are no longer sufficient to free the world, including the U.S., from nuclear threat. According to Peter Huessy, “Four successive arms control agreements—the INF treaty, START I, the Moscow treaty, and New START—reduced the U.S. nuclear arsenal by close to 90 percent. Yet, over that same period, China multiplied its nuclear force, Pakistan and India produced hundreds of nuclear weapons, North Korea amassed a stockpile of nuclear devices…” Despite all assurances to the contrary, it is not clear if Iran continues to seek nuclear weapons.[33]

CONCLUSION

A flexible and resilient nuclear enterprise is an essential hedge in the event that U.S. nuclear deterrence is tested. Hence, maintaining a safe, secure, effective, and reliable nuclear stockpile requires modern facilities, technical expertise, and tools to repair any malfunctions quickly, safely, and securely and to ensure full capability of the nuclear enterprise. Service life extension programs have supported continued nuclear capabilities. The U.S. nuclear enterprising is aging and must be upgraded to maintain its integrity in the perception of its enemies. Other nuclear-armed countries are modernizing to avoid obsolescence, and the U.S. cannot lose sight of this reality. Genuine modernization and replacement efforts will take time and may turn out to require additional funding than is currently programmed. Whatever the case, it is certain that the U.S. cannot progress and need not expect to advance further in any undertaking, nuclear or otherwise, than its chosen trajectory will take it.

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Mr. Brian Mathias is an Acquisition Program Manager supporting the Air Force Life Cycle Management Center (AFLCMC), Arlington, VA. He holds a B.S. in Flight Technology and Operations and a MBA from Bowling Green State University, and a M.S. in Weapons of Mass Destruction Studies from Missouri State University. He was previously assigned as an Acquisition Program Manager at AFLCMC, Wright Patterson AFB, OH, where he supported the Simulators Division in multiple acquisition and sustainment efforts. Mr. Mathias is a National Defense University Countering Weapons of Mass Destruction Fellow.
brian.mathias@jsf.mil

PLANNING FOR THE U.S. NUCLEAR FORCE IN THE POST-NEW START DECADES

John Schmitt
Defense Threat Reduction Agency

INTRODUCTION

Under current plans, the U.S. could potentially spend over a trillion dollars on the nuclear enterprise over the next 30 years, yet a Congressional Advisory Panel recently argued that complacency, a lack of focus, and poor leadership have plagued the U.S. nuclear enterprise in the post-Cold War decades.[1] Considering the critical importance of the U.S. nuclear deterrent and the vast sums of money required to sustain, operate, and modernize the forces, it is not clear that a commensurate degree of government interest or analysis has focused on the combined costs of all the programs and the necessity of each program in meeting deterrence objectives in the post-New Start Treaty (NST) years. Further nuclear reductions through either arms control or resulting from the massive costs of the arsenal are likely over the next thirty years. Hence, a viable proposal for managing the nuclear forces in the light of 21st-century fiscal realities and U.S. strategic security objectives is urgently needed. U.S. must look at the potential return on investment of modernizing each leg of the triad with an eye toward creating a cheaper, smaller, yet modern and capable deterrent. To that end, this essay will argue that this goal could best be achieved by:

- retiring the B61 gravity bomb,
- eliminating the fixed winged portion of the triad, and
- focusing instead on revitalizing and sustaining the sea- and land-based ballistic missile legs of the triad

as the United States plans the nuclear force of the post-NST future.

AIR FORCE B61 GRAVITY BOMB

During the Cold War, thousands of nonstrategic nuclear weapons were deployed by the U.S. in Europe. Over the decades, these weapons also served as an important political element of NATO's cohesion as an Alliance.[2] However, by November 2010, the NATO Strategic Concept Statement indicated that deterrence was based on an appropriate mix of nuclear and conventional capabilities, and that the strategic nuclear forces were the supreme guarantee of security, making no mention of non-strategic nuclear forces.[3] Accordingly, leaders from Belgium, Germany, Luxembourg, the Netherlands, and Norway called for the U.S., in 2010, to remove all nonstrategic weapons from Europe, arguing that they served no military purpose. A 2011 Government Accountability Office (GAO) audit reported that neither NATO nor U.S. European Command have prepared standing nuclear contingency plans or identified targets involving

nuclear weapons. According to the GAO, the bombs are merely intended to link the U.S. and NATO and tangibly assure members that the U.S. is committed to NATO members' national security.[4] Even so, at the April 2010 NATO Ministerial meeting in Talin, Estonia the Foreign Ministers agreed that no nuclear weapons should be removed from Europe unless all 28 member states agreed.[5] Against this backdrop, in the 2010 NPR, the U.S. committed to a full-scope Life Extension Program (LEP) of the B61 bomb to ensure the safety, security, and confidence in the weapon as well as the functionality of the weapon on the next generation fighter.

Already an expensive modernization effort, this program has so far been mired in controversial cost over-runs. According to a 2011 GAO report, the DoD had planned on delivery of the refurbished weapons to begin in 2017 and the LEP to be complete by 2022. Meanwhile, the National Nuclear Security Administration (NNSA) had estimated the total LEP cost to be approximately $4 billion.[6] However, due to delays in scoping and studying the B61 LEP, as well as the impending end of service life of the bombs, the DOE will be forced to complete just-in-time maintenance actions on existing bombs simply to keep them functional prior to the LEP completion, which has further increased costs.[7] By July 2013, the B61 LEP initial delivery date had been pushed back to 2019[8] and it is now pushed to beyond 2020.[9] Contributing to the delays are technical and programmatic complexities associated with the LEP that the DoD's Cost Assessment and Program Evaluation (CAPE) offices reported are 3-4 times greater than the current ongoing W76 warhead LEP.[10] Worse, costs have escalated, up to $8 billion as reported by the NNSA[11], up to $10 billion as reported by the CAPE office[12], and as high $13 billion as reported by the James Martin Center for Nonproliferation Studies.[13]

Before spending ten billion dollars to refurbish several hundred bombs, which have questionable military utility and are no longer wanted in Europe by several of the key NATO allies, the Alliance must answer the question, "Will they still be necessary in the post-NST era?" During a briefing on April 8, 2010 on the NPR, the Vice Chairman of the Joint Chiefs of Staff and the former Commander of U.S. Strategic Command (STRATCOM) unequivocally stated that there are no military missions performed by dual-capable aircraft (DCA) delivered nuclear weapons that cannot be performed by either U.S. strategic forces or U.S. conventional forces.[14]

While a visible display of U.S. commitment to NATO may be warranted, especially in light of recent Russian aggression, spending upwards of $10 billion on an overly complex and technically risky nonstrategic nuclear weapons upgrade may not be the best way to provide that display. Recent U.S. troop deployments to the Baltics and Poland are unplanned expenses, but they serve as a valuable "trip-wire" function to deter Russian aggression. Not spending billions on the B61 upgrade and instead focusing on other nuclear programs like the SSBN(X) program or Minuteman improvements, as well as maintaining the unrivaled U.S. conventional capabilities would arguably better synchronize U.S. acquisition plans with the NATO Strategic Concept. The B61s are rapidly

approaching the end of their service lives; and rather than spend billions sustaining them, retiring them should not be dismissed out of hand.

AIR FORCE BOMBER PROGRAMS

The Air Force's B-52 dual-role bombers are now over 60 years old and the average age of the U.S. bomber force is 33 years old.[15] The Air Force is committed to replacing the B-1, B-2, and the B-52 with a next generation bomber, but the priority for that aircraft has been the conventional mission since the Air Force publically began the effort over a decade ago.[16] There is no doubt that Russian and Chinese built air defenses are exponentially more sophisticated today than ever before. It is also very likely that the Air Force needs a new conventional bomber to replace the increasingly aged and vulnerable B-52, B-1, and B-2 in order to conduct conventional operations. However, it is not clear that the analysis and determination whether to purchase a next generation bomber should be made on the basis of considerations that assume for the bomber a nuclear mission. Even now, only about a dozen B-52s are routinely dedicated to the nuclear mission.[17] This reality, coupled with the fact that the Air Force's next-generation is slated to be fitted for nuclear duty only retroactively,[18] means that, for all practical purposes, the U.S. nuclear strike force is already more "dyad" than "triad".

NAVY SUBMARINE PROGRAMS

The 2010 Nuclear Posture Review (NPR) characterizes the "strategic nuclear submarines (SSBNs) and the SLBMs they carry" as "the most survivable leg of the triad".[19] This characterization is widely accepted by defense planners and deterrence theorists. Moreover, these submarines feature an important interoperability characteristic that traces back to the 1958 Mutual Defense Agreement (MDA) between the United States and the United Kingdom (UK). Currently, the UK leases Trident II (D-5) missiles which carry U.S. W76 warheads. Due to collaboration with the U.S., the U.K.'s "Successor-class" SSBNs, which are slated to deploy in 2028, are expected to share missile launch compartments, reactors, and other propulsion technologies with the Ohio-class replacement SSBN.[20] The U.S. and the U.K. nuclear deterrents are very closely tied and therefore, the U.S. must not only take into consideration its' own needs when replacing the Ohio-class SSBN, but also the needs of its important ally.

THE SSBN(X)

In 2010, the Defense Acquisition Board approved the Navy's plan to replace the 14 Ohio-class SSBNs with 12 SSBN(X)s, each with 16 launch tubes capable of accommodating the Trident II (D-5), with procurement to begin in 2019 for initial deployment in 2029. Due to less planned maintenance requirements associated with the new reactors on the SSBN(X), the Navy was confident that in a crisis it could meet potential wartime surge requirements with only 12 total SSBN(X)s in the fleet.[21]

This gain in efficiency, however, comes at a not insignificant cost: The 12 submarines constitute only 4.5 percent of the total number of new ships in the 2014 shipbuilding plan, yet they account for 15 percent of the estimated costs. However, the Navy remains committed to the SSBN(X) program as evidenced by Chief of Naval Operations (CNO), Admiral Jonathan Greenert's September 18, 2013 Congressional testimony in which he stated that the program was the Navy's top priority even if Budget Control Act (Sequestration) caps further reduced the total Navy budget.[22] Several options exist for lowering overall costs of the SSBN(X) program to include altering or reducing procurement, conducting block purchases with a similar Virginia-class attack submarine, or funding the procurement outside of the Navy's normal shipbuilding budget.[23] The CNO first proposed the notion of funding the SSBN(X) outside of the shipbuilding budget by suggesting $60 billion in supplemental funding over 15 years, during September 12, 2013 testimony. The CNO pointed out the supplemental payment would equate to less than one percent of the annual DoD budget and that the first SSBNs were funded in a similar manner in the 1950s and 1960s.[24]

The Navy continues to produce new rocket motors, other components, and execute LEPs in order to maintain the Trident II (D-5) missile system through 2042.[25] Currently, there exists no obvious necessity to replace the Trident II (D-5) SLBM, as the next generation SSBN(X) and the U.K.'s Successor-class SSBN are being designed to be compatible with the existing missiles. The overwhelming majority of Trident missiles carry the MK4/W76 nuclear warhead, which is currently undergoing a LEP designed to add 30 years to the warhead life "by refurbishing the nuclear explosive package, the arming, firing, fusing system, the gas transfer system, associated cables, elastomers, valves, pads, cushions, foam supports, telemetries, and other miscellaneous parts".[26] Originally, the Navy had planned to conduct the LEP on only about 25 percent of the W76 stockpile, but has reportedly expanded the LEP to 60 percent of the stockpile. Estimates indicate that 500 of the planned 1200 warheads have already been refurbished and deployed.[27] The W76 refurbishment program began prior to 2009 and is scheduled to be completed in 2019, with the DOE's FY12 budget request including $259.2 million for the W76 LEP.[28]

Despite these costs, the SSBNs are the most survivable leg of the triad and are necessary for deterrence. They carry a large second strike capacity and retain a technical capability to carry many more warheads than currently limited by the New START Treaty. Additionally, the Trident II missiles and warheads will be the most modern in the U.S. nuclear arsenal, with service lives that extend to 2042 for the missile and even further for the warheads. The warheads will also be interoperable with Air Force missiles, which will reduce sustainment costs and provide an inter-service technical hedge against warhead failure. It makes little sense to have spent billions modernizing and extending the service lives of the missiles and warheads, and not invest in the replacement submarines. The relative maturity of the modernization plan, planned warhead interoperability with the Air Force, and the operational advantages of the SSBNs place a high emphasis on maintaining and continued modernization of the Navy's contribution to the U.S. nuclear forces in the post-NST era.

AIR FORCE ICBM PROGRAMS

Of all the legs of the triad, silo-based Intercontinental Ballistic Missiles (ICBMs) are projected to be the least expensive of the three systems to operate over the next ten years. Much like the Trident II, the Minuteman III has recently undergone an extensive LEP and is expected to remain in service until 2030.[29] Beginning in 1998, the Air Force has poured new fuel into the first- and second-stage rocket motors and remanufactured the third-stage motors[30] so that the currently deployed Minuteman missiles "are basically new missiles except for the shell".[31] Additional programs completed in the past decade have replaced the guidance systems and post-boost propulsion systems and have improved the targeting capability across the fleet.[32] Another program was completed which integrated the MK21/W87 warheads that were previously mounted on the Peacekeeper ICBM onto the Minuteman, and is expected to extend the W87 service life beyond 2025.[33] Current Minuteman III modernization programs extending through 2023 include initial development of a replacement ICBM, modernization of the warhead fusing, refurbishment of the W78 and W87 warheads, and design integration of both warheads into the standardized configurations.

According to a Rand study, a Russian attack on the U.S. ICBM forces would still require more than 900 Russian warheads, or almost 60 percent of their NST totals, to guarantee destruction of the 400 single-warhead missiles and the associated launch control center. Even with possible improved accuracy, the Rand study determined that any potential future adversary would still need to employ a disproportionately larger force in order to eliminate the U.S. silo-based single-warhead force.[34] Rand further determined that as long as the U.S. maintained numerical parity with Russia through NST or another future arms control agreement, the survivability of the ICBM force is no longer as important as it was in the Cold War and expensive efforts to increase ICBM survivability are not necessary.[35] The Rand analysis recommended the incremental upgrade option to the current Minuteman III missiles and silos, as that would be more sustainable than simply attempting to maintain existing airframes and less costly than developing a new ICBM or any mobile missile option.[36] Further, the incremental upgrade option is essentially a continuation of the Air Force policy of perpetuating the Minuteman through LEPs and component upgrades that has been in place since the end of the Cold War.[37] The Rand study's preferred, incremental improvement option is ultimately the most cost effective option to replace the Minuteman III, and it provides the flexibility to cancel the program or eliminate all or a portion of the missiles and silos should a future arms control agreement further limit the nuclear force structure.

CONCLUSION

Due to years of neglect, the U.S. nuclear forces are aged, and the nation will spend billions replacing systems over the next decades, despite a policy of reducing the role of nuclear weapons in national security strategy and a historically decreasing trend-line in numbers of launchers and warheads. This is the reality of successive administrations and the DoD's policies of continually

disregarding the nuclear deterrent and pushing replacement and modernization programs further into the future in order to pay for other more pressing needs or to recoup savings. Unfortunately, the U.S. is at a dramatic crossroads and is looking at the prospect of simultaneous multiple multi-billion dollar replacement programs for all three legs of the nuclear triad. Under the current DoD plan, scholars from the James Martin Center argue that the U.S. could ultimately lose both Air Force legs of the triad and end up "disarming by default" as Congress and the taxpayers may balk at funding the triad at Reagan-era levels. Rather they propose that the U.S. should fund the nation's deterrent based on geopolitical and fiscal realities.[38] Ultimately, reducing the number of nuclear weapons and delivery systems in a managed manner as the force modernizes and remains capable is possible in the post-NST era.

The U.S. will assume some risk by removing the fixed-winged component from the triad through the retirement of the systems. However, the fixed-winged contributions, both tactical and strategic, to nuclear deterrence have transformed significantly since the 1960s, when the arguments for the triad were first formulated. The fixed winged contribution is a shell of its former self. This fact must be acknowledged by today's U.S. policy makers, as their outdated perceptions of the triad have no place in a fiscally constrained reality. In October 1969, 176 nuclear armed bombers were sitting on alert, while dozens more were overseas preparing to bomb and mine North Vietnamese cities and harbors.[39] By 1990, the bomber contribution to the triad still consisted of about 260 nuclear-capable bombers, with dozens of bombers and crews at a dozen bases on nuclear alert. Today, about a dozen bombers at a single base are even committed to the nuclear mission with the crewmembers rotated in for only one-year tours. The aircraft are not maintained on alert and the weapons are all centrally stored. With plenty of advanced warning, a handful of aircraft could possibly be loaded with nuclear weapons and launched on missions. However, both the aircraft and missiles are likely not survivable against the air defense networks of most nuclear adversaries.

On the tactical side, the U.S. only reportedly maintains a small force of very aged B61s bombs in a few key NATO countries.[40] Reportedly, several of the countries that share responsibilities for these weapons have requested their removal. While NATO in general and a few countries in particular, are concerned with the large Russian stockpile of nonstrategic weapons, the Alliance has put its faith in strategic nuclear forces of the U.S., the U.K., and France as the supreme guarantor of security.[41] The nuclear acquisition plan should recognize the actual minimal contribution that fixed-wing aircraft provide to deterrence in 2014 and not be bound simply by Cold War-era perceptions and slogans. Since the Russian annexation of the Crimea in March 2014, the U.S. and other allies have maintained nearly continuous deployments of conventional air and ground forces to the nations of Estonia, Latvia, Lithuania, and Poland as demonstration of both military and political solidarity. The deployments of U.S. forces are additional and costly actions that the U.S. took to reassure allies and demonstrate that the U.S. security to commitment to Europe is unshakeable. Unlike the ambiguous commitment to the B-61 demonstrated by several key NATO allies, U.S.

efforts like the European Reassurance Initiative demonstrate a tangible and unambiguous commitment to the Alliance.

Depending on the source, the cuts proposed herein are in the $30 billion range; approximately $10 billion for the B61, and another $20 for the air launched cruise missile (ALCM) and the follow-on long-range stand-off (LRSO) weapon. These proposed cuts may pale in comparison to the $6.4 - $7.2 billion estimated cost for each SSBN(X) submarine. However, the considerable retaliatory capability of as many as 6-8 warheads on each on-call Trident missile is a far superior deterrent to missiles and bombs that only leave the storage bunkers for periodic training exercises. While small, these cuts are necessary in order to ensure the nation can direct the proper funding to the programs that provide the most value and capability — the sea- and land-based ballistic missile legs.

Some may argue that heavy bombers can provide deterring "signaling" to adversaries in a potential crisis. Through decades of indifference to the fixed winged nuclear mission, the Air Force has undermined the credibility of this leg of the triad, and the accidental shipment of nuclear armed cruise missiles signaled this failure to the world. The Air Force has done much to correct the damage since, but the bomber contribution to triad is still minimal in comparison to the other legs of the triad and investments are not feasible in what could be a fiscally constrained and arms control limited post-NST future.

Others could argue that the U.S. could lose the flexibility that bombers provide the triad. However, the U.S. and the Air Force forfeited much of the bombers flexibility by stationing most of the bombers and all their associated nuclear weapons at just two bases.[42] The weapons are secured in the storage areas and the aircraft are not armed and ready for launch, which could make for an inviting and debilitating first-strike target in a crisis. Bombers can only be flexible if they are survivable, and their routine basing method allows for easy and inviting targeting by an adversary. The retention of the ALCM does not promote the principle of flexibility, as it is extremely vulnerable to adversary air defenses, and it seems that the Air Force is only maintaining an exposed missile in order to bridge the gap to something that might be more capable but would only be available 15 years from now. The existing nuclear-armed bomber leg is not the same bomber leg that is lauded in traditional triad discussions for flexibility and deterrence signaling, and expensive nuclear force structure decisions must not continue to be based on outdated perceptions.

Eliminating the fixed winged contribution to the U.S. nuclear force and retiring the outdated weapons could provide enough means to fund and focus the emphasis on higher return-on-investment systems like SLBMs and ICBMs. The current acquisition plan which assumes that the DOE will be funded for six straight years at four times the current annual rate[43], and that the Navy shipbuilding plan will be nearly 40% greater than the average annual rate for thirty consecutive years[44] is out of step with fiscal reality and assumes significantly more risk than removing the minimal contribution of fixed winged aircraft from the equation. Yet, that is the situation that the U.S. faces after decades of not investing in the nuclear

forces. The U.S. will be forced to accept some risk and the DoD cannot continue to parrot the Cold War mantra that the triad provides stability at a reasonable cost. That statement rings hollow to taxpayers at a trillion dollars total over 30 years and upon evaluation of the fixed-wing contribution to the triad. However, if the DoD honestly advocates what the sea- and land-based ballistic missile legs provides the U.S. in credible nuclear deterrence and acknowledges that the forces have long been overlooked, then larger investments in the nuclear forces might be an easier pill for Congress and the taxpayers to eventually swallow.

When acquiring this new and more modern post-NST nuclear force structure, the DoD should consider a force structure in the future that is smaller, and more consistent with the overall decline in nuclear forces that has occurred over the past 45 years. The current Minuteman and Trident missiles and the Ohio-class SSBNs have significant excess capacity to upload additional warheads if the geo-political situation warrants it. As seen in the NST implementation plan, the Navy has the capability to further download missiles or warheads if a future arms control treaty further constrains the U.S. nuclear forces. Investing in modernization of these legs provides not only a secure retaliatory force with the SLBMs and stabilizing force with the ICBMs, but the flexibility to expand or contract the force if the need arises. Further, the ICBM force provides a numerical parity with and is operationally focused against Russia. Since the ICBM modernization is potentially the cheapest of any the modernization programs and is essentially a perpetuation of the existing force, any cuts or even elimination of the entire force through bilateral agreement with Russia will result in relatively minimal wasted “new” investment. There is no guarantee that the U.S. will need to or even want to reduce the size of the nuclear force in the post-NST years. However, by investing in SLBMs and ICBMs only, the U.S. will optimize its nuclear deterrent capacity to the greatest extent that the uncertainties of the future will enable it to predict.

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Mr. John Schmitt is the Conventional Treaties Data Manager at the Defense Threat Reduction Agency (DTRA), Fort Belvoir, VA. He holds a M.S. in Weapons of Mass Destruction Studies from Missouri State University. He was previously a B-52 and B-1 crewmember in the U.S. Air Force and a START Inspector at DTRA. Mr. Schmitt is a National Defense University Countering Weapons of Mass Destruction Fellow.

BUILDING THE NUCLEAR DETERRENT OF 2035

Joseph M. Burke
Army Staff

THE DESCENDING TRAJECTORY

The U.S. relies on an aging nuclear weapons stockpile for its nuclear deterrent: no new weapons have been built since 1991 and most of the stockpile is considerably older. The U.S. policy to reduce overall numbers of nuclear weapons has limited new nuclear weapon development, including the research, development, testing, and experimentation (RDTE) of new weapon designs. Significantly, the testing limits do not permit underground test(s) (UGT) of nuclear explosives – a proven method that assures weapons will reliably function as designed. Additionally, the oversight of the nuclear weapons stockpile is divided between the Department of Defense (DoD) and the Department of Energy (DOE), a situation that has resulted in challenges in both identifying and correcting shortfalls in sustaining the current stockpile and preparing for future deterrence needs.

Present-day U.S. nuclear deterrence continues to be based on the Cold War concept of mutually assured destruction and the procedures developed to support that capability. The adversary the U.S. deters is generally understood to include nation-states that have nuclear capabilities that can attack the U.S. or its military allies. Russia remains the most likely nuclear adversary, though certainly not the only one that the U.S. may have to deter from using nuclear weapons in the near future. As an example of the current Russian threat, Payne writes that, "…The evidence since 2012 is that Putin's assertive nuclear moves are becoming even more dangerous, including a reported doctrinal innovation that ironically envisions Russia's first use of nuclear weapons as a form of nuclear 'de-escalation'— that is, if Russia uses nuclear weapons in a local conflict, opponents will cease resistance, thus de-escalating the crisis."[1] A possible scenario such as Russia attacking the Baltic states of Latvia, Estonia, and Lithuania with conventional forces in support of protecting Russian ethnic minorities—and neutralizing a NATO response from Poland with a Russian tactical nuclear strike—would fit Putin's de-escalation rhetoric.[2] The current U.S. nuclear deterrence capability will have to remain credible to deter Russia's de-escalation policy (and rhetoric). Additionally, the deterrence policy will need to deter regional adversaries such as North Korea and Iran that currently threaten U.S. regional allies and, in the future, may threaten the U.S. mainland. The U.S. deterrence capability may also need to adjust to sudden shifts in the geopolitical landscape due to unexpected changes in the government of a U.S. ally. By the fact that the U.S. retains nuclear weapons, it has the ability to threaten an adversarial nation-state from taking action. The certainty of an adversary's vulnerability to nuclear destruction remains the most credible threat to deter the

decision of another country's leadership to act against the United States. Without a modern and well-maintained nuclear arsenal, the U.S. faces a spectrum of threats from both state and non-state actors with destructive intentions.

From 1945 to 1990, the United States produced an estimated 70,000 nuclear weapons of approximately 70 types for more than 120 different weapon systems. From the mid-1950s to the mid-1960s, the U.S. surged in warhead and weapon research, development, testing, and evaluation (RDTE) as each military branch wanted a special nuclear weapon for specific missions. In the peak production years of 1959 and 1960, warheads came off the assembly lines at a rate of 27 per day—about 600 a month. The many categories of "need" included various anti-submarine weapons (launched from ships and subs as well as dropped from helicopters), atomic land mines, artillery shells, surface-to-surface missiles in all ranges, air-to surface and surface-to-air missiles, every size of gravity bomb for dozens of different nuclear-capable bombers, and three-dozen nuclear-capable tactical aircraft. In 1967 the operational stockpile reached a peak of about 32,000 warheads.[3]

The United States used a combination of nuclear weapon testing, non-nuclear testing, and evaluation to develop its Cold War nuclear arsenal. This effort included using under-ground testing (UGT) to refine designs in the nuclear warhead's development stage, certify the weapon designs and production processes, validate the weapon safety, estimate weapon reliability, detect any production or operational defects, and confirm effective repairs. Additionally, a formal acquisition process, program management, and life cycle management with formal funding processes was developed for each nuclear warhead and supporting delivery system. In order for a nuclear weapon to be fielded, it had to go through a documented and specialized development, testing and evaluation, initial and subsequent full-scale production, and, finally, fielding for possible wartime employment. During and after fielding, nuclear warhead stockpile activities included exchanging limited life components, detecting components with design or aging defects and replacing them, conducting periodic validations for safety, and updating reliability estimates. The designers also had the opportunity to research and develop additional safety, security, and operational design features in more sophisticated nuclear weapon designs to replace the fielded weapon. These designs were used in modernization programs timed to provide replacement weapons after the older warheads had been deployed for a period of 15-20 years, a period known as the "protected period."[4]

During the "protected period," the U.S. conducted programmed quality assurance testing on the stored and maintained nuclear warheads. The quality assurance testing would detonate one nuclear weapon per year for each type of deployed nuclear weapon. At the end of the protected period, the older weapon would begin the retirement process; while concurrently, the replacement nuclear weapon system would be in the production and fielding process. In this way, the U.S. nuclear arsenal was continually replenished by newer nuclear weapons. The new weapons design would have better safety and security features and meet the required yield. This nuclear weapon acquisition cycle ensured that the

United States had an extremely modern, sophisticated stockpile supported by a substantial nuclear and non-nuclear component production capacity. In this way, the United States used UGT to develop newer, better nuclear weapons to replace the aging weapons.[5]

Enabling the life cycle management of each weapon system was a complex military-industrial infrastructure that participated in every step of the RDTE and production life cycle of the warhead and its supporting weapon systems. During the early Cold War years, the Atomic Energy Commission (AEC) focused on designing and producing nuclear weapons and developing nuclear reactors for naval propulsion. The Atomic Energy Act of 1954 ended exclusive government use of the atom and began the growth of the commercial nuclear power industry, giving the AEC authority to regulate the new industry. In 1977, the AEC was incorporated into what became the Department of Energy (DOE), which brought most federal energy activities under one management framework for a comprehensive and balanced national energy plan. In the 1980s, DOE identified nuclear weapons research, development, and production as its primary priority.

The nuclear Triad resulted from the U.S. operational need to ensure nuclear weapon survivability from improved Soviet capabilities while providing options for nuclear employment based on Presidential needs. “Intercontinental Ballistic Missiles (ICBM) eventually had the accuracy and prompt responsiveness needed to attack hardened targets such as Soviet command posts and ICBM silos, [and] Submarine Launched Ballistic Missiles (SLBM) had the survivability needed to complicate Soviet efforts to launch a disarming first strike and to retaliate if such an attack were attempted.”[6] The third component of the nuclear triad, strategic bombers, “could be dispersed quickly and launched to enhance their survivability, and they could be recalled to their bases if a crisis did not escalate into conflict.”[7] These assumptions continue to underlie the U.S. nuclear triad today.

Even so, the U.S. nuclear deterrent has been radically re-shaped since 1991. After the Soviet Union fell in 1991, the U.S. emplaced a unilateral moratorium on UGT. Halting UGT was seen as an important step toward full nuclear disarmament because it would put a high barrier against developing new weapons. However, as a byproduct of this moratorium, the U.S. nuclear weapons complex began to deteriorate, particularly production facilities. The nuclear weapon acquisition process mirrored the Cold War acquisition process, only now focused on maintaining elements of the current stockpile rather than on developing new weapons.[8] Moreover, DOE worked on environmental cleanup of the nuclear weapons complex, nonproliferation activities, and maintaining the nuclear stockpile, while DoD maintained the nuclear triad at increasingly reduced levels. The U.S. continued to maintain the triad of strategic nuclear forces that provided a range of flexibility for U.S. national leadership in nuclear planning and also complicated an adversary’s attack planning. It also provided a “hedge” of extra weapons in case any unexpected technical problems occurred with any single warhead or delivery system.[9]

In the 2010 Nuclear Posture Review (NPR), the Obama Administration's indicated that the U.S. will retain a triad of ICBMs, SLBMs, and heavy bombers as the U.S. reduced its forces to the limits in the New START Treaty.[10] It also outlined several guiding principles in the U.S. nuclear stockpile management:

- The U.S. will not conduct nuclear testing and will seek ratification and entry into force of the Comprehensive Test Ban Treaty;
- The U.S. will make decisions on how to sustain specific warheads on a case-by-case basis;
- The U.S. will not develop new nuclear warheads; life extension programs (LEPs) will be based on designs that are, or have been, in the U.S. stockpile and will not provide new military capabilities or support new military missions;
- LEP decisions will be made on a case-by-case basis with strong preference given to refurbishment or reuse. Replacement of nuclear components will require presidential and congressional approval.

In 2013, the Obama Administration issued revised Nuclear Employment guidance in the form of a Presidential Decision Document and DoD restated in its nuclear employment strategy that it would retain the nuclear triad.[11] President Obama posited that the U.S. could meet its strategic requirements with a force up to a third below the New START levels (the New START limits a force structure of 400 ICBMs with 400 warheads, 240 SLBMs with 1080 warheads, 60 heavy bombers, and no more than 1550 warheads deployed on strategic delivery vehicles). In 2015, the Defense Department's new strategic guidance made clear that nuclear weapons were playing a shrinking role in U.S. national security strategy with improved conventional capabilities.

The long term plan for the mix of warheads is based on a "3+2" strategy, i.e., three ballistic missile Nuclear Explosive Package (NEP) types that are certified on both USAF and USN delivery systems, plus two air-delivered NEP types certified and deployed in both cruise missile (i.e., Air launched Cruise Missile [ACLM] / Long Range Stand Off [LRSO]) and gravity bomb weapons systems.

SUSTAINING THE NUCLEAR STOCKPILE

At the time of their original production, the nuclear weapons were not designed or intended to last indefinitely. The nation's three types of nuclear bombs are slowly undergoing LEPs in which some parts are replaced and others are updated. Some of the parts are virtual museum pieces, such as the B61 gravity bomb's fusing system, which still uses vacuum tubes.

In 2009, the U.S. Government Accountability Office (GAO) conducted a study on U.S. National Nuclear Security Administration (NNSA) and DoD management of the nuclear weapon stockpile LEP.[12] The GAO reported that NNSA and DoD did not effectively manage cost, schedule and technical risks to either the B61 or W76 life extension programs. The GAO noted that NNSA completed refurbishment on the strategic variants of the B61 bomb but did not meet all the

refurbishment objectives. The GAO reported that NNSA established an unrealistic refurbishment schedule and failed to fully implement its own refurbishment guidance. Despite DoD concerns about the adequacy of NNSA testing of the B61 bombs under certain conditions, NNSA continued to refurbish the weapons.

The NNSA is refurbishing the aging W76 nuclear warhead with the goal of extending the warhead life by 30 years. The W76 LEP experienced significant delays in startup and achieving production goals, and by the end of Fiscal Year 2011 NNSA had completed less than half of the anticipated units due to technical production issues. Delays increased the risk that the W76 LEP and follow-on weapon refurbishments would not meet delivery commitments to DoD. Until the W76 LEP is completed, NNSA cannot meet the scheduled FY 2018 start date for refurbishment of the tactical nuclear B61 bomb that is needed to meet United States' commitments to the North Atlantic Treaty Organization (NATO). This is the same weapon system NATO requires to counter the ten-fold advantage in tactical nuclear weapons that a newly assertive Russia maintains. According to the DOE Inspector General, facility limitations preclude beginning work on the B61 LEP until the W76 LEP is complete.[13] Additionally, the program is faced with a relatively flat budget over the next few years, even though its annual scope of work is projected to increase significantly. The program's budget increases for Fiscal Years 2013 and 2014, for example, were only 2.9 percent in each year more than FY 2011 levels. The program's production schedule, however, shows production increasing 59 percent during the same period. The increase in production was unsustainable given the projected funding.[14]

RELIABILITY OF THE NUCLEAR STOCKPILE

NNSA continuously assesses and evaluates the reliability of each nuclear weapon system to certify its reliability and to detect problems that occur as a result of aging. NNSA depends on precise information concerning how each specific nuclear weapon was built to certify its reliability. Given its importance, such information is controlled through a formal configuration management (CM) process.[15] Under the CM process, the exact "as-built" product definition of a nuclear weapon is required to be maintained throughout its life cycle.[16] The as-built product definition is similar to an index, in that it contains an exact list, by version, of the drawings, specifications, engineering authorizations, manufacturing records, and any other essential documents used in the development and qualification of a nuclear weapon system or component. The DOE Inspector General (IG) has identified instances in which the NNSA did not maintain accurate and complete CM information for its nuclear weapons and components, including the use of nuclear weapons parts and components that did not conform to specifications. In one instance, this resulted in a significant cost increase. NNSA sites could not always locate drawings for nuclear weapons and components in its official records repositories. For example, Pantex Plant officials could not locate as-built product definitions for 39 percent of the nuclear weapons DOE IG selected from the current stockpile for testing. In addition, of the 22 nuclear weapons with as-built product definitions, Pantex could not locate all the associated drawings for 59 percent of the nuclear weapons DOE

IG selected from the current stockpile for testing. Further, because the original documented as-built product definition could not be located, DOE IG could not confirm that the product definitions developed by Pantex were precisely the same as the originals.[17]

Regarding nuclear weapons components, NNSA could not always ensure that new parts would actually fit in a nuclear weapon. For instance, Sandia National Laboratory (SNL) officials responsible for neutron generator components, a key component of a nuclear weapons system, could not locate 44 percent of the drawings identified in the as-built product definitions. Additionally, SNL was uncertain whether the available information constituted a complete as-built product definition for the neutron generator. These drawings were important as the neutron generators remained in the weapons stockpile but had been produced by a production site that was closed.

The Los Alamos National Laboratory (LANL) CM information system allowed unauthorized changes to classified nuclear weapons drawings. LANL officials were unable to explain why changes were made, but told that they "assumed" the changes were needed. NNSA standards require that once a drawing had been approved for production, the drawing is "read only" and cannot be modified. DOE IG review of parts that did not conform to design specifications associated with the W76-1 LEP determined that 63 percent did not have the assurance that the component was suitable for use in a nuclear weapon.

At SNL, 15 percent of authorizations did not have the required technical justification. In one case, this situation resulted in component production to be delayed by one year and additional costs of between $20 and $25 million to correct problems associated with the use of nonconforming parts.[18]

Currently NNSA determines stockpile requirements and provides annual updates on materials, to include tritium. In order to produce this critical component, tritium-producing burnable absorber rods (TPBAR) are irradiated in nuclear power reactors and then processed. If technical exigencies required a production surge, it would take at least four years and require $20 million in order to meet growing tritium requirements. DOE is also concerned that current tritium production capability may be at risk as parts required for TPBAR will be exhausted by 2016. Due to NNSA budget constraints, these replacement parts have not been procured.[19]

The NNSA also uses precious metals, such as gold, silver, and platinum at its national laboratories and production sites for research and development as well as weapon component construction. Federal regulations require NNSA to maintain control of these materials to ensure no excess precious metals are retained and return excess for other federal uses. The DOE IG reviewed NNSA procedures and noted that the sites maintained excess precious metals (in some cases for over 40 years) and disposed of contaminated precious metals that could have been decontaminated and recycled (in 2010 this estimated at $23.2 million worth of precious metals).[20] The DOE IG concluded the root cause to be

NNSA lack of oversight of laboratories by not following its own requirement of conducting yearly reviews. This lack of oversight required NNSA to purchase additional precious metals for laboratory use.

Control of actual nuclear materials is also of concern. Federal regulations require NNSA programs to detect, assess, and deter any unauthorized access to any nuclear materials used in weapons related projects. The DOE's Y-12 Complex has processed highly enriched uranium (HEU) for over 60 years but had a HEU loss in 2014 (a HEU sample was discovered in a laundry truck that tripped an alarm as it left Y-12's protected area).[21]

Without nuclear testing, there exists a possibility that one weapon-type after another would be retired prematurely because of an inability to correct emerging problems, which might eventually lead to unintended withdrawal of one of the warheads without a replacement warhead available. Deviations from original designs generally occur only as a result of "sunset" technologies (where technologies that originally produced items no longer exist) or manufacturing processes that cannot be replicated due to health or environmental restrictions.[22]

The U.S. policy of a refurbishment-only nuclear stockpile maintenance strategy had two major shortfalls:

- First, as a growing number of incremental changes are made to nuclear weapons through the refurbishment process, the further away from their original specifications the weapons become. Because these weapons were built to specific yield-to-weight ratios, very little margin for error from very exact specifications is allowable. Any deviations could negatively impact the performance of the weapon in safety, security, and reliable yield.[23]
- Second, the refurbishment-only policy greatly complicates the introduction of changes to improve safety or security performance with new technological improvements. Currently fielded stockpile weapons have safety and security features that were developed in the 1970s and 1980s (to include vacuum tubes). Today, the U. S. has the technical capacity to produce safety and security features that are superior to those legacy features in the current warheads. However, the refurbishment LEP process does not allow for incorporating these more effective safety and security features without UGT ensuring that they do not corrupt the functioning of other safety, security, and yield characteristics of the weapon.[24]

Additionally, NNSA is required under current policy to be able to resume UGTs at the Nevada test site within three years of being ordered to do so. The UGTs would include identifying a new nuclear weapon problem or resolving issues on reliability of the nuclear stockpile. Prior to performing any UGT, the site must conduct various safety analyses and also conduct nuclear explosive safety studies in order to meet nuclear explosive safety standards. The DOE noted in 2002 that its ability to conduct an UGT within three years was "at risk." The DOE IG reported that at that time it has lost 50% of its employees with actual testing experience and much of the equipment used in UGT was unserviceable,

obsolete, or was no longer supported by the manufacturer. Additionally, facilities used in UGT had been converted to other uses, mothballed, or dismantled. The safety studies were also outdated and would not meet current safety requirements. The DOE IG re-inspected the Nevada test site in 2009 and noted the test readiness capabilities had continued to deteriorate.

Finally, the acceptance of nuclear weapons parts and components that do not meet specifications has potential readiness, reliability, cost, and timeliness implications. For example, in one case, this situation resulted in a 1-year delay in component production and additional costs of approximately $20 to $25 million. Further, inadequate reviews of commercial-off-the-shelf parts led to NNSA having to recall several refurbished W76-1 weapons due to significant safety and reliability concerns.[25]

In a 2008 Report to Congress, NNSA set a goal to dismantle all nuclear weapons retired prior to Fiscal Year (FY) 2009 by the end of FY 2022. In April 2011, NNSA reiterated the goal. DOE internally reported that potential issues related to the infrastructure for staging nuclear weapons, nuclear weapon components, and other weapon components at Pantex could impact future dismantlement efforts and other directed stockpile work programs.[26] It was not clear that the infrastructure for staging nuclear materials might not be able to provide the level of protection required for safe and secure staging operations of nuclear materials. The report noted that special nuclear materials are vulnerable to theft or diversion; these included weapon components, plutonium, and uranium because of multiple security failures to include maintaining critical security equipment. The staging and storage magazines examined were 45 to 65 years old and needed varying degrees of repair due to the erosion of the earth above them, roofing maintenance, repairs on the foundation, and repairs associated with the heating, ventilation and air conditioning systems.

NNSA also noted Pantex warehouses for weapon components were nearing capacity levels. Specifically, Pantex has the requirement to store and maintain nuclear weapon components. According to a Pantex report, the warehouses used for such storage are about 86 percent full and could determine if Pantex had sufficient storage capacity to meet future mission requirements. Pantex faces challenges in managing its limited warehouse capacity. In an effort to not add components to the legacy workload, Pantex has prioritized the characterization, sanitization, and disposition of surplus components generated from the active dismantlement programs over the legacy components. Further, according to a Pantex official, components that are designated as active and ready for use may not be needed by the current stockpile.[27]

LOOKING AHEAD: FUTURE NUCLEAR POLICY

In order to reduce the risk of not having a credible nuclear deterrent against current and future adversaries, four key policies merit review and possible revision:

CHANGE THE PROHIBITION TO UNDERGROUND TESTING

Current policy does not permit UGT, which prior to 1992 was standard practice for each weapon type in the nuclear stockpile. Since that time, the testing has been analytical and relied on previous weapon data. As the weapons age and LEPs continue with subtle changes in design, parts, and delivery systems, the reliability of the weapon becomes more questionable as it is not based on actual demonstration.

Key political and defense leaders underscore the imperative of testing. For example:

- John Hamre, former Deputy Secretary of Defense in the Clinton administration and now president of the Center for Strategic and International Studies: "We should get rid of our existing warheads and develop a new warhead that we would test to detonation…We have the worst of all worlds: older weapons and large inventories that we are retaining because we are worried about their reliability."[28]
- Congressman. Mac Thornberry (R-Texas), Chairman of the House Armed Services Committee: "It seems like common sense to me if you're trying to keep an aging machine alive that's well past its design life, and then you're treading on thin ice. Not to mention, we're spending more and more to keep these things going….You don't know how a car performs unless you turn the key over. Why would we accept anything less from a weapon that provides the foundation for which all our national security is based on?"[29]

It can be argued that scientific data alone can replicate testing – minimizing or even eliminating the need for it. For example, Siegfried Hecker, a former director of the Los Alamos National Laboratory and now a professor at Stanford University, argues that testing could cause another problem: a resumption of U.S. testing would probably prompt other nuclear powers to resume as well, allowing them to catch up with the U.S.'s huge experimental lead.[30] The U.S. has an expansive and unrivaled archive of test data, having conducted 1,032 nuclear tests, followed by Russia with 715 nuclear and trailed by China with only 45 nuclear tests. Hecker suggests that the U.S. has so much experience, data, and scientific capability that it could build a new generation of weapons without testing.

While scientific data can replicate existing warheads, it cannot replicate future warhead designs on future delivery systems, nor account for documented design and modification variances in weapons post-LEP. Scientific data also cannot anticipate future delivery platforms that may be necessary to counter adversary defensive capabilities. Moreover, a radical increase in nuclear weapon testing world-wide is unlikely based on historical data. The U.S. and Russia had the most detonations before 1991 but ceased testing in 1992. An estimated combined total of 16 UGTs have been conducted by China, India, Pakistan, and North Korea.[31] The U.S. and Russia still retain large scientific weapon information, and limited UGTs to existing stockpiles would be an acceptable risk.

Additionally, resumption UGT would address weapons post-LEP effectiveness, and permit a new generation of nuclear test personnel to refresh the aging work force and attract engineers and support skills which are currently lacking in the workforce. New weapon testing can also serve as deterrent to nations seeking to assess the U.S. credibility in maintaining nuclear weapons capability, and reassure allies about U.S. capabilities and dissuade those same nations from developing indigenous nuclear capabilities.

DESIGN NUCLEAR WEAPONS TO MEET FUTURE THREATS

Policy should also change to permit designing new weapons. John S. Foster Jr., former Director of Lawrence Livermore National Laboratory and Chief of Pentagon research during the Cold War, argues that labs should design, develop, and build prototype weapons that may be needed by the military in the future, including a very low-yield nuclear weapon that could be used with precision delivery systems; an electromagnetic pulse (EMP) weapon that could destroy an enemy's communications systems; and a penetrating weapon to destroy deeply buried targets.[32]

Scientific and technological advances since 1991 can provide improved safety, security, targeting, options for employment, or new mission sets. Improved production capabilities with 3-D technology, composite materials, enhanced EMP, and miniaturization of component size could combine to enable future U.S. delivery systems to survive current and future enemy advanced air defenses. Thus, the U.S. could actually move from a Cold War triad based on massive nuclear destruction to one based on a precise, nuclear counterforce response against deeply buried underground facilities or electrical power grids without the collateral damage produced by current weapons.[33] Such a developmental effort could be expected to attract a new generation of engineers and support skills to apply to new weapon designs and retain for future nuclear RDTE efforts.

REVISE THE NUCLEAR TRIAD

Consolidation of legs of the triad with a reduction in the ICBM or SLBM forces could permit investment in modern or planned dual-use technologies. Examples such as the hypersonic glide vehicle (HGV) could include a nuclear warhead or drone technology such as unmanned aerial or undersea vehicles. Using smaller nuclear warheads that could be delivered by multiple platforms such as unmanned aerial und undersea vehicles would frustrate adversary targeting. Additional advances in materials could also reduce signature and improve survivability if faced with improved enemy air and ballistic missile defense.

The opportunities for future investments in new technologies with dual applications also would encourage commercial innovation to retain the intrinsic U.S. technological edge over potential adversary countries. A current example is the Boeing Company, which is actively engaged in developing hypersonic technology and would benefit from additional investments in RDTE in this area.[34] By encouraging development of new weapon systems, a next generation

of nuclear weapon designers will improve the long term health of the nuclear enterprise by invigorating the nuclear work-force with the next generation in designers and engineers.

REORGANIZE THE APPARATUS FOR NUCLEAR OVERSIGHT

Critics of the NNSA suggest that the creation of a semi-autonomous organization has failed, with many GAO and DOE IG findings noting cost overruns and missing key milestones in program execution. One possible way to address these concerns could be to make the NNSA a defense agency, with its reporting chain through the Department of Defense leadership. This would fix accountability through a cabinet-level secretary and refocus the emphasis from a scientific research that supports the military mission of the nuclear enterprise. The re-alignment of the NNSA as a defense agency could help ensure that policy development and transparent communications between the supporting nuclear production facilities and military services occurred with DoD-level oversight. The Office of the Secretary of Defense with Acquisition, Logistics, and Technology (OSD-ATL) has the ability to synchronize acquisition policy for emerging technologies, work with Service and Joint Program Mangers; and partners within the Defense Contracting Management Agency to coordinate with the civilian defense industrial base to align programs in product acquisition. Direct DoD oversight could also reduce documented inertia of labs and NNSA policy by unifying chain of command and increasing a unity of effort to align with future RDTE efforts with DoD requirements.

CONCLUSION

The need for U.S. nuclear weapons remains so long as the international security environment is informed by the presence of nuclear weapons anywhere in the world—especially in the hands of near-peer competitors or nations demonstrably hostile to the U.S. The credibility of the U.S. nuclear weapons needs to improve as the nuclear arsenal is aging without replacement. The pre-1991 nuclear weapons remain the deterrent upon which U.S. relies, while U.S. policy continues to reduce the overall number of weapons in its nuclear arsenal. This same policy has placed limits on any new nuclear weapon growth and limits ensuring the weapons are completely reliable. With no new production, testing, or weapon designs, the U.S. nuclear stockpile loses the certainty of functioning as a credible deterrent.

The advances in science and technology since 1991 can enhance safety, security, and reliability of the deterrent. New production techniques such as 3-D printing can produce parts not even imagined when the original warheads were being designed. Future designs can incorporate potentially revolutionary innovations. The opportunity to take the Cold War deterrent forward is possible, but will require policy change. By not taking action to ensure our stockpile is credible, the U.S. loses the certainty of deterring an adversary. Concurrently, the U.S. will increase the uncertainty of its national security and survival.

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BIOGRAPHY

Mr. Joseph M. Burke is the Insider Threat Program Manager at the Department of the Army Protection Directorate in Washington DC. He holds a B.A. in Communications from the City University of New York at Queens College, a M.A. in History from Jacksonville State University, a M.A. in National Security Studies from the Navy War College, and a M.S. in Weapons of Mass Destruction Studies from Missouri State University. He was previously assigned as Critical Infrastructure Program Manager and CWMD Policy Analyst for Department of the Army and is a retired Army Lieutenant Colonel in the Chemical Corps. Mr. Burke is a National Defense University Countering Weapons of Mass Destruction Fellow.
joseph.m.burke4.civ@mail.mil

STRATEGIC UNCERTAINTY: RISKS ASSOCIATED WITH UNILATERAL NUCLEAR REDUCTIONS

Donald Parman
Defense Threat Reduction Agency

INTRODUCTION

Throughout the long history of warfare and regardless of the weapon types involved, unilateral disarmament has rarely, if ever, produced lasting peace. Effective arms reduction has always required the active and verifiable participation of all relevant parties. After all, the purpose of arms reduction is not to reduce arms per se; it is to reduce threats. Since many political and military leaders acknowledge the unprecedented threat posed by nuclear weapons, it is understandable that they would seek to reduce or eliminate them. Accordingly, since the end of the Cold War, the United States has repeatedly reduced its nuclear arsenal, unilaterally and otherwise.

While the decision to reduce arms is ultimately a political one, it is not a decision bereft of consequences for those charged with the obligation to render "best military advice." Hence, regardless of what political ends reductions may achieve, they produce at least three enormously significant challenges for military planners:

- they complicate force-on-force strategic planning;
- they weaken deterrence credibility with allies and negotiation credibility with adversaries; and
- they ignore strategic cultural considerations concerning how an adversary may respond negatively to such reductions.

IMPACT ON FORCE-ON-FORCE PLANNING

Unilateral reductions can greatly constrain the ability of planners to array the nuclear arsenal against adversarial threats. A flexible response force with varied capabilities allows national leaders to keep a conflict at the lowest level while negotiating for an end to hostilities, while a unilaterally reduced arsenal limits the options planners have to recommend optimally tailored response packages. Ordering a full nuclear attack to respond to a limited strike of a few weapons serves no logical goal and will result in a full response from an opponent. For example, prior to the Cuban missile crisis many strategists believed that a nuclear attack was an all or nothing strategic event. President Kennedy stated during the crisis that any nuclear missile launch from Cuba against any target in the Western Hemisphere would be regarded as an attack by the Soviet Union on the United States and it would be met with a full military response.

Also constrained is the ability of operators, once hostilities have begun, to respond to adversary nuclear escalations. Escalation control allows for one weapon or many to respond to a threat posed by any part of an opponent's arsenal of weapons, the supporting industrial base, leadership targets or command and control structure. Targeting flexibility allows for a conflict to be terminated at the lowest possible level by responding in-kind to a limited attack, buying time for political solutions. As more potentially adversarial states acquire nuclear weapons, the need for broader strategic escalation control options increases.

Moreover, unilateral reduction implies not only a reduction in the number of warheads; it ultimately also implies reductions in infrastructure. The larger the number of nuclear staging bases maintained by the United States, the more complicated the targeting task of an adversary becomes. As present, the United States has three remaining nuclear aircraft staging bases, two nuclear submarine bases, and deployed nuclear alert submarines at sea. This is already a small number of nuclear staging base targets for a peer- or near-peer nuclear adversary to plan against. Unilateral reductions exponentially increase the risk to the United States while commensurately simplifying the targeting task for an adversary.

There are 450 nuclear missile silos remaining in the nuclear triad that presents a challenging set of individual targets for any opponent. Missile launch silos are hardened, physically separated, and very survivable which represents a formidable individual targets to any opponent. Missile launch silos are hardened, physically separated, and very survivable which represents a formidable deterrent to any adversary. Intercontinental Ballistic Missile (ICBM) launch complexes and missile silos were intentionally separated by a minimum of ten miles between each silo and the launch control center (LCC) where missile crews stand ready to execute launch on command of the national command authorities. The ICBM component of the nuclear Triad represents the best option for a limited response to most threats because each missile can be launched separately and ballistic warheads can penetrate most defense systems.[1] Each missile has built in redundancy to allow for command and control by at least five separate LCCs and a back-up aircraft based airborne launch and control system. Unlike their sister service Submarine Launched Ballistic Missiles (SLBMs), the ICBMs have redundant command and control launch capability and communications systems. ICBMs can be launched while under attack through several backup systems.[2] By comparison, submerged nuclear submarines have slow delayed communications connectivity that may delay launch while messages are received and verified. Thus, unilateral nuclear reductions must first take into consideration the impact on the flexibility of a U.S. response to aggression and the vulnerability of strategic nuclear forces to attack. Politicians and planners must recognize that unilateral reductions to the Triad force structure will directly impact the individual and collective capability of the nuclear forces to respond appropriately with flexibility and survivability to any threat from adversaries impacting deterrence credibility.

Any decision to reduce nuclear forces must take into consideration that no planner can guarantee that all nuclear weapons systems will reach their intended targets in the face of opposition forces and changing technology. Even if generated to alert, U.S. nuclear systems will face modern high-powered defense systems such as the Russian S-500 anti-aircraft, anti-missile system. The United States has not previously had to plan for this new perimeter defense weapon system, which bombers and missiles would have to breach.[3] Such new technology would alter the strategic balance of deterrence forces and make any reductions impractical; indeed, it could result in a requirement for *increased* numbers.

IMPACT ON DETERRENCE AND NEGOTIATIONS

Nuclear force reduction policy must consider the impact on deterrence, which is not a precise art, but one that must create doubt and strategic respect in the minds of opponents. Although deterrence is a difficult concept to measure, it is the foundation of U.S. nuclear policy. Consequently, both politicians and military planners must carefully weigh the potential effects of unilateral reductions on deterrence.

Unilateral reductions fail to take into consideration that proper decisions on the amount of nuclear forces and any reductions to those forces must be determined by a balance of capability versus threat and what is needed to neutralize that threat. Creating in the mind of an opponent the belief that an unacceptable retaliatory strike would be launched against anyone who has launched an attack against the United States is the stated objective of America's nuclear deterrence strategy. Some argue that one bomb is enough, others demand a variety of systems, and still others promote the idea that the threat of nuclear attack can be reduced or eliminated entirely through political agreement.

Unilaterally reducing the nuclear forces also unavoidably impacts the confidence other nations have in U.S. extended deterrence agreements. Thirty countries have the potential and resources to develop nuclear weapons but instead have chosen to put their faith and confidence in the U.S. extended deterrent capability.[4] The North Atlantic Treaty Organization (NATO) has expressly stated that the alliance is built on collective defense with nuclear capability provided by the United States as the key component.[5] NATO leaders have insisted that forward deployed U.S. tactical nuclear weapons remain in Europe as a deterrent to aggression.

Unilateral reductions do not demonstrably support negotiations calculated to encourage other nations to make similar concessions. Nuclear powers have reached agreement in the past on nuclear arms reductions, but only when one party has perceived an unacceptable threat to a strategic deterrence balance of forces with the opponent. In the 1980s, at the height of the Cold War, both East and West possessed over 20,000 weapons, either active or in reserve stockpiles. Over the past 2 1/2 decades the United States and Russia have agreed to reduce the numbers of weapons and some types of weapon systems,

with the U.S. claiming a reduction of over 75% since the fall of the Berlin Wall.[6] A key to the success of these agreements was obtaining concurrence on the types, locations, and numbers of weapons at various locations or basing sites, and a subsequent verification of that data through a baseline visual assessment.[7] Agreed bilateral reductions then followed. In contrast unilateral reduction decisions by the United States, such as the Presidential Nuclear Initiatives (PNIs) of the 1990s, which resulted in less U.S. capability, and thereby less negotiation leverage when dealing with Russia, produced no verifiably reciprocal reductions by Russia.[8] Although unilateral cuts to forces may be intended to ease tensions when an imbalance threatens deterrence, to dispel potentially destabilizing perceived of advantage in capability, or even simply to show good will, little if any evidence can be brought to bear to demonstrate that unilateral eliminations by the United States have done much, if anything, to encourage other states to follow suit.[9]

Moreover, despite all inducements to the contrary, some states remain outside of international agreements constraining nuclear development and do not share the desire to achieve a nuclear weapons-free world. Globalization poses an additional risk, since border and export controls are loosened in efforts to promote trade. That easing of control has been exploited in some cases to acquire materials necessary to make a bomb. The most widely known example is the A.Q. Kahn terrorist network that previously supplied nuclear enrichment materials to rogue nations including Libya and North Korea —all against the backdrop of unilateral nuclear reductions by the United States.

Twenty first century nuclear arms reductions must take into account not only Russia but also the complicated dynamics of a multi-polar nuclear world. Unilateral reductions effectively ignore this dynamic because, apart from negotiated outcomes with appropriate verification regimen, there simply is no way to know what the full extent of the multi-polar nuclear dynamic actually is. Indeed, as the Wiesner paradox suggests, if countries treat nuclear weapons as valuable components of their arsenals, then as fewer nuclear weapons exist, the ones that remain become increasingly valuable and they will be much more resistant to reductions.[10] This makes the idea that an adversary state would simply reduce its arsenal because the United States unilaterally does progressively less credible.

IMPACT ON ADVERSARY PERCEPTIONS

Nuclear weapons still represent the ultimate weapon in the arsenal of nations around the globe. Possession of those weapons indicates a sophistication and developmental capability that gives the possessor, at a minimum, a perceived higher status in the nuclear club.[10] The President of China has stated that nuclear states with larger arsenals (obviously referring to the U.S. and Russia) must reduce their arsenals first, implying that only through unilateral or bi-lateral reductions would China and others consider further reductions.[11] Other countries seeking to join the nuclear club see U.S. unilateral reductions as a way to level the threat posed against them by the United States.

Any unilateral or strategic arms control reductions must consider the cultural dimensions of cooperation and expectations of adversarial nations. National leaders may have their own cultural or political motivations which may include a political desire to promote national security while demanding to be treated with equal respect by any adversary. Religious and territorial disputes such as those between India and Pakistan are examples of nations with regional issues of culture that must be considered when offering unilateral or negotiated nuclear reductions. Terrorist attacks against India which were supported by Pakistan have already occurred and could pose a real and present nuclear danger as both states have a nuclear arsenal. Their consideration of unilateral disarmament is unlikely due to the problems of enforcement, unequal compliance, and uneven implementation. Compliance with international norms for such nations may be perceived as a loss of cultural prestige, security, and respect. If nations such as these believe there is inequity, then the result could be a desire to support nuclear proliferation to match or oppose perceived or actual threats to the balance of deterrence forces.

Theorists have suggested several culturally based conditions which the United States should take into consideration when making decisions concerning unilateral reductions or negotiations. These conditions are: the identities of national cultures; dominant leaders; and also the military organizations. These factors have several implications for policy-making and academic research. The first implication is that a lack the cultural understanding makes deterrence less than a complete success in all situations. The second is that there needs to be a variation in the deterrence strategy that incorporates more specific attention to institutions, values, and culture in the target countries. Third, there needs to be more cross-national comparisons of systematic attention to cultural determinations of strategy. The fourth implication is that external threats possibly create a sort of cultural resonance that actually makes a national identity stronger.[12] For example, current Russian arms buildups are supported by the population because President Putin has managed to successfully convince the citizens that Russia is threatened by the West. There appears to be a convergence of strategic culture studies with contextualizing strategic choice based on real or imaginary threats. Future U.S. foreign policy for reductions must incorporate these strategic cultural factors and not propose unilateral reductions. The result will be more successful negotiations with verification protocols and a tailored balance of deterrence.[13]

Some areas of the world are immersed in cultural and religious battles of ideology and desire military superiority to achieve political and religious objectives. Nuclear weapons are viewed as symbols of superior power and respect. It appears that the current U.S. deterrence policy is failing due to the rise of nuclear programs and modernizations seen in Russia, Iran and North Korea.[14] In the Middle East the probable outcome of Iran acquiring nuclear weapons will be a cascade effect of nuclear proliferation in the region as Saudi Arabia, Oman, Egypt and others as they seek a defensive parity or superiority to protect their cultural identity and national assets. The Non Proliferation Treaty (NPT) would be severely weakened if not critically damaged by such an outcome.

All efforts to stop the spread of nuclear weapons would be undermined by this development. This would also be viewed as a failure of U.S. policy, and a major diplomatic defeat in the region and around the world. Those who acknowledge the proliferation concerns in the Middle East recognize that unilateral nuclear weapon reductions do nothing to quell the cultural and strategic desires to obtain or maintain similar weapons.

Problems for unilateral reductions are numerous because a culture of violence exists around the globe. This cultural violence, which sometimes escalates into larger conflict, has often been found to have a basis in political disagreement, religious differences, religious fanaticism, or is the product of criminal activity. Weapons do not represent the reasons for cultural violence or political conflicts and banning them through written agreements has proven to be problematic and unreliable. Decision makers have acknowledged that nuclear deterrence has a proven track record of success spanning decades despite or perhaps because of the destructive nature of nuclear weapons in the face of numerous cultural and political disputes. The consequence of seeking to unilaterally disarm under the assumption that the nuclear weapons are the reason for conflict ignores the more logical cultural or political basis.

In Russia and China, defense expenditures are justified against real or perceived threats by leaders who have a shared cultural history of wars, invasion, and memories of the high loss of life in the Second World War. Attempts to gain Russian or Chinese reductions in nuclear arsenals must recognize cultural history and motivation for bargaining with assurance that they are left with superior capability or at least parity with potential adversaries. Unilateral reductions to the nuclear arsenal would potentially eliminate any leverage the United States has to motivate arms control negotiations with Russia and China.

Another area of cultural concern is that of nuclear terrorism which is criminal activity often based on cultural, religious or ethnic bias. Counter-terrorism logically represents a reason to seek or support a Nuclear Zero program because the threat and likelihood of non-state actors acquiring a nuclear device would decrease if all weapons were destroyed. However, cultural fanatics or rogue states could obtain nuclear materials through networks such as the A. Q. Khan network and supply nuclear terrorists with weapons to use for the regimes' coercive or destructive purposes. They could potentially develop a weapon or a dirty bomb themselves. As some argue for the Nuclear Zero movement, the likelihood of a universal ban on nuclear weapons that could be enforced, or even agreed to, is not a certainty. Since eliminating the science and knowledge skill sets needed for nuclear weapons is impossible, politicians and planners must create a national security strategy that considers the potential of cultural fanatics or terrorists finding a way to acquire a nuclear weapon or device with the intention of using it.

A potential area of cultural concern for unilateral nuclear reductions and negotiations is that other national leaders may perceive U.S. unilateral disarmament as weakness, or arrogance, or both. It has been stated that

achieving a world without nuclear weapons, Nuclear Zero, is a worthy goal to work toward.[15] The high moral ground for such a position has been echoed by national military and civilian leaders at meetings such as the Nuclear Summit and in President Obama's Prague speech. But what if the U.S. example of unilateral disarmament was culturally viewed as talking down to an adversary? For example, Russia culturally expects to be treated as an equal and for any negotiations to represent goals of national interest and asset parity. Bargaining represents a transaction where each participant brings something of equal value to any negotiation. Strategic respect includes the recognition that an opponent is negotiating from strength and shared intent, not from good will gestures which indicate superior attitudes or strength.

Animosities between the United States and potential nuclear adversaries either predates possession of nuclear weapons by one or the other party or else does not fundamentally stem from the threat of nuclear weapons per se. This is certainly true of Russia which, although an ally in World War II, was hardly a nation that the United States felt it could trust over the long term. It is also true of Iran and China, whose respective regimes' antipathy for the United States dates back at least as far as the time of their respective revolutions, if not earlier. While the United States might intend unilateral reductions to serve as a gesture toward the lessening of tensions, there is no evidence whatsoever in which to base the argument that unilateral nuclear reductions actually facilitate this aim. Indeed, Russia has not offered any unilateral reductions in its tactical nuclear weapons. If anything, Russia may be expected to demand that any nuclear reductions on its part include the promise of future treaty negotiations include U.S. anti-missile defense systems—and all of this as Russia continues fielding anti-aircraft and anti-missile systems on its borders. U.S. withdrawal from the Anti-Ballistic Missile (ABM) Treaty and subsequent development of anti-missile systems had the stated intent of deploying those systems to defend Europe and the Pacific theater against rogue states and actors. Russia views these programs as an aggressive move to position missiles near its borders, thereby hindering negotiations toward any nuclear reductions.[16]

Unilateral nuclear reductions by the United States become particularly problematic in light of policy decisions that Russia considers to be antagonizing, such as any political or military signal that a former Soviet client states would be formally covered by the U.S. nuclear umbrella.[17] Indeed, from a Russian perspective, Russia's defensive border is gradually being taken away as the U.S nuclear umbrella unfolds and while NATO fields anti-missile weapons in the former buffer states of the Warsaw Pact. As NATO programs become increasingly robust Russian planners see little or no reason to reciprocate either past or contemplated U.S. unilateral nuclear reductions. Instead, the trend represents, and can only represent the planning need for Russia to increase the number of defensive weapon systems in the opposition to the perceived nuclear threat which must be countered.

The effect of U.S. unilateral nuclear reductions is further complicated by heterogeneous perceptions with the United States itself. Specifically, U.S.

planners must consider three different types of strategic culture: national strategic culture; military strategic culture; and service strategic culture. All three of these aspects of U.S. strategic culture react to U.S. unilateral nuclear reductions, and the reaction is not necessarily based on the same set of considerations.[18]

- For example, there is a strong national strategic cultural taboo against using nuclear weapons for limited warfare rooted in the belief that once they are released that they cannot be controlled. This cultural taboo extends itself to a national strategic culture that opposes peaceful nuclear explosions and even to controls on nuclear power production and materials. Hence, it is difficult for some to imagine nuclear weapons to have any utility whatsoever beyond the fact of their possession.
- Nuclear weapons have had a limited enduring impact on the way the U.S. military conceives of war, because these weapons have largely been perceived by military planners as weapons of last resort, existing to deter or retaliate against a similar attack by an adversarial nuclear state.[19]
- In comparatively stark contrast, the individual the military services have, to one degree or another and from one time to another, embraced a service cultural desire to play a role in nuclear deterrence and defense—if for no other reason than to assert relevance or to secure a larger "slice" of the budget "pie".

One of the major domestic incentives for pursuing unilateral nuclear arms reductions is lowered expenses for the national budget. However, while the cost savings that reductions afford may seem politically appealing, unilateral reductions can just as easily create vulnerabilities that must be compensated for by larger and more expensive conventional force options. In addition to the potential size and expense of such options, it also should be noted that the effect of trading a lessened nuclear threat for a heightened conventional threat is one that is easy to predict.

Each country the U.S. seeks to reach agreement with on nuclear weapons will have unique cultural issues to address. Consequently, U.S. policy makers must recognize that unilateral nuclear arms reductions may not be viewed by negotiating partners in ways imagined by the United States. Moreover, U.S. policy makers must not lose sight of the historical lesson of "peace through strength" that has figured prominently into reduction negotiations ever since the Peloponnesian War. For example, with the best intentions the Budapest Memorandum was signed in 1994 by Russia, Great Britain, the United States and Ukraine promised that the signatories would not use force against Ukraine and would honor its borders in exchange for removing all nuclear weapons systems. Effectively, Ukraine went from being the 3rd largest nuclear power in the world to Nuclear Zero and also reduced conventional forces based on the assurances of this agreement in order to reduce the national budget. Now Ukraine is in a state of turmoil and at the forefront of a new heightened conflict between NATO and Russia, despite strong historical and cultural ties to Russia (Ukrainians founded Moscow as part of old Russ). In the negotiations the vulnerability was clear; the promises were precise. The conflict stands as an example of unilateral reductions

which unintentionally led to unchecked vulnerability and widespread strategic uncertainty across Europe.

CONCLUSION

In sum, unilateral arms reductions are fraught with perils that no state can afford to ignore. They pose significant challenges for military strategic planners who, although they do not make national defense policy, must deal with the constraints imposed by unilateral reductions of any kind, especially nuclear reductions. Moreover, history provides policy makers with few if any substantive reasons to assume that the good will ostensibly intended by unilateral nuclear reductions will be reciprocated. This is especially true as the nuclear world becomes increasingly multi-polar, thus defying the basic assumptions undergirding nuclear arms control negotiations during the Cold War. Security strategists, all the while desiring a more peaceful world, must nevertheless approach security challenges as they actually present themselves and not merely as it may be wished that they should be. Consequently, the ultimate efficacy of unilateral nuclear reductions is something that raises many more questions than it affords reliable answers.

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BIOGRAPHY

Mr. Donald Parman works for the Defense Threat Reduction Agency, Fort Belvoir, VA. He holds a B.B.A. in Management from Angelo State University, a M.A. in Business Administration from Central Michigan University, a M.S. in Weapons of Mass Destruction Studies from Missouri State University. Mr. Parman is a National Defense University Countering Weapons of Mass Destruction Fellow.
donald.e.parman.civ@mail.mil

CENTRALIZED MANAGEMENT OF UNITED STATES NUCLEAR COMMAND AND CONTROL COMMUNICATIONS (NC3)

Craig S. Roblyer, Sr.
Defense Threat Reduction Agency

INTRODUCTION

The President of the United States, the sole authority for the employment of U.S. nuclear weapons,[1] must be able to communicate to U.S. nuclear forces from anywhere, at any time, and through any threat environment. The President's ability to command and control U.S. nuclear forces is assured by multiple layers of nuclear command and control communications (NC3) systems, collectively known as the NC3 system. Nevertheless, this system, conceived during the Cold War, merits a thorough 21st-century reevaluation with an eye toward modernization and *centralization.*

In 2014, Congress expressed concerns about the development and funding of NC3 systems in the Department of Defense (DoD) due to "fragmentation" caused by the spread of funding and responsibility across many services and agencies.[2] Although the U.S. Air Force is responsible for about 75% of the systems that make up the NC3 system; the U.S. Navy, the Defense Information Systems Agency, the White House Communications Agency, and various other agencies are responsible for the rest. Placing a single authority in charge of the NC3 system would ensure designated resources were properly utilized. The United States Government Accountability Office (GAO) reported to Congress that DoD programs are too often duplicative, citing fragmented management as one of the causes.[3] Where the NC3 System is concerned, duplicative programming (redundancy) is not necessarily a bad thing. However, the NC3 system is fraught with inefficient redundancy beyond what purposefully facilitates the system's purpose. Unhelpful fragmentation of the NC3 system is further exacerbated by the fact that different Services and agencies define NC3 differently (if they define it at all). Fundamental confusion over the term has resulted in the inclusion of systems and elements within the NC3 system that are not communications-related and do not enhance the President's ability to communicate to nuclear forces. Admiral Cecil Haney, Commander of U.S. Strategic Command, reported to the Senate:

Assured and reliable NC3 is fundamental to the credibility of our nuclear deterrent. The aging NC3 systems continue to meet their intended purpose, but risk to mission success is increasing as key elements of the system age. The unpredictable challenges posed by today's complex security environment make it increasingly important to optimize our NC3 architecture while leveraging new technologies so that NC3 systems operate together as a core set of survivable and endurable capabilities that underpin a broader, national command and control system.[4]

As Admiral Haney notes, aging NC3 systems pose a risk to national deterrence. He points out the need to optimize the NC3 architecture and leverage new technologies. Consolidating U.S. NC3 systems into a single system managed by a single organization, under the guidance of a single decision-making authority, would streamline the delivery of the core set of survivable and endurable capabilities to which Admiral Haney refers.

In recognition of these and similar concerns, the RAND Corporation recommended consolidating responsibility for the architecture, systems engineering, and sustainment engineering for Air Force NC3 into a single organization.[5] Although the recommendation could improve NC3 management fragmentation and unify decision making authority within the Air Force, it ultimately fails to address fragmented management across the DoD. In 2013, the DoD established the Joint Systems Engineering and Integration Office (JSEIO),[6] with the mission to support the services and agencies that govern NC3 by providing day-to-day systems engineering, end-to-end system integration, and gap analysis and investment strategies needed to close critical gaps.[7] However, since JSEIO's role is advisory instead of authoritative, services and agencies continue to make decisions at the individual program level rather than at an enterprise level.[8] Since service-led programs tend to lead to service-focused and service-serving solutions, expanding RAND's recommendation to centralize management to include all U.S. NC3 systems may well offer the best overall solution: A single organization should manage the entire NC3 Enterprise as a single system.

ESTABLISHING A SINGLE AUTHORITY FOR THE NC3 SYSTEM

Placing the systems, resources, and authority for the NC3 system within a single DoD-level agency would establish cohesion in planning and promote a common NC3 culture.[9] A key component to centralizing management of the more than 100 systems that make up the NC3 system would be setting up a single program office. All the care and feeding of the NC3 system would flow through this single NC3 Program Office. Under the current management structure, not only is the NC3 system split up between multiple services and agencies, the individual systems within the NC3 system are managed by separate program offices within each service and agency. The resulting effect is an NC3 system patched together by disparate program offices.

Centralizing management of the NC3 enterprise would promote a shared understanding of enterprise priorities. Currently, different services and agencies offer different definitions of NC3 (if they define it at all). The primary issue continues to be the mischaracterization of the term NC3 as a list (e.g., "nuclear command, control, and communications"). This resulted in the inclusion of systems and elements within the NC3 system that are not associated with communications. Placing a single authority in charge of the NC3 system would ensure resources designated for NC3 will be used for NC3. Moreover, centralization might yield significant economic benefits. The many program offices could reorganize into a single, larger, program office. A centralized

program office directly reduces the overhead of operating multiple facilities. Separate facilities require separate lease agreements, utility deposits, insurance policies, security features, office equipment and supplies, and network and phone system applications.[10] Even though the new NC3 program office would likely be larger than any of the current program offices, the NC3 system itself would require fewer human resources than the system requires at present: A single Program Executive Officer (PEO) and support staff, along with streamlined apparatuses for administrative and information technology (IT) support, contracting officers, etc., would all contribute to this end. Having a single PEO would likewise streamline the acquisition process, and in particular, the requirements management process (i.e., the process of documenting, analyzing, tracing, prioritizing, and agreeing on requirements and then controlling change and communicating to relevant stakeholders).[11]

ENABLING AND DEVELOPING SPECIALISTS

Optimizing the organizational structure for governing the NC3 system would include enabling and developing an array of specialists, from the engineers who design the communications systems to the end-users who communicate through the systems. Consider the following:

- The DoD already has tremendous communications expertise spread out among many services and agencies. Realigning the many NC3 systems into a single NC3 system governed by a single DoD agency would align the priorities and focus the work of NC3 system communications experts. Co-locating various communication system specialists offers a variety of additional benefits in the form of hardware and software standardization. The current diversity of communication systems, rather than synergizing in a way that promotes essential redundancies, actually complicates the smooth movement of information across the enterprise.
- The unprecedented threat that the United States now faces in the cyber domain, which includes the internet, but also intranets, cellular technologies, fiber-optic cables, and space-based communications,[12] poses commensurately unprecedented risks to the viability of the NC3 system. In recognition of this threat, the Defense Science Board recommended the U.S. Secretary of Defense assign U.S. Strategic Command the task to ensure the availability of NC3 and the nuclear triad delivery platforms[13] in the face of a full-spectrum, state sponsored cyber-attack. Clearly, consolidation would greatly enhance full-spectrum counter-cyber efforts as they pertain to the NC3 system. While countering the cyber threat does not, by itself, assure NC3 connectivity and functionality, it is nonetheless essential to the reliable function of the system. Working together, communications and cybersecurity specialists can make sure protective measures are considered early and often in existing system sustainment and modernization, and new system development and acquisition.
- Whereas cybersecurity specialists seek to defend U.S. systems from adversarial intrusion and disruption, information warfare (IW) specialists seek to intrude and disrupt U.S. adversaries. Within the NC3 system

cadre of specialists, IW experts, examining U.S. NC3 systems from an adversary's perspective, can identify existing and potential weaknesses. IW specialists then work within the cadre to help develop protection measures. Naturally, their efforts across the breadth of the enterprise need to be complementary, just as those of information management and cyber security specialist must be.

- The urgency of acquisition reform has been widely acknowledged across the DoD, and this urgency exists in the case of the NC3 system as well. The acquisition process, which includes design, engineering, test and evaluation, production, and operations and support of defense systems, is extremely complex by its very nature,[14] and avoidable inefficiencies in the process currently impose unacceptably long delivery timetables on products vital to the function of the NC3 system. As one example among many that could be given: In August 1999, Air Force Space Command (AFSPC) awarded two competitive contracts for the Advanced Extremely High Frequency (AEHF) System, the satellite system designed to replace the secure communications capabilities of the MILSTAR satellite network. However, full operational capability of the system is not projected to occur until 2017,[15] 18 years after the contract was awarded.

OPTIONS FOR THE FUTURE OF THE NC3 SYSTEM

In light of the benefits of NC3 system centralization, three alternatives seem to present themselves, each representing the most logical choice from each of three echelons: The U.S. Air Force from the service level, U.S. Strategic Command (USSTRATCOM) from the joint military level, and the Defense Information Systems Agency (DISA) from the DoD level.

At the service level, the USAF stands out as the obvious choice to manage the NC3 system because it owns the preponderance of U.S. NC3 systems. The Air Force, however, is not without problems where NC3 governance is concerned. According to a study conducted by the RAND Corporation; "The various systems that constitute the Air Force portion of the NC3 system are scattered throughout the Air Force, with many under the operational purview of Air Force Global Strike Command (AFGSC). No single organization is responsible for the overall Air Force NC3 architecture, systems engineering, or sustaining engineering."[16] RAND further pointed out that NC3 planning, programming, and risk assessment functions were separated from the rest of the nuclear mission. In response, the USAF is transitioning management of all Air Force-owned NC3 systems to AFGSC.

Even if the USAF demonstrated superb management of Air Force-owned NC3 systems, should management of the remainder of the U.S. NC3 system be transferred to the USAF? For two reasons, the answer is no. First, the Air Force likely will place a higher value on the systems necessary to meet its own mission requirements; placing lesser emphasis on systems supporting other services and agencies. Second, the Air Force's location choice for centralizing NC3 system management is, quite simply, unappealing to the many experts required

to maximize NC3 system effectiveness within available resources. AFGSC is located at Barksdale AFB near Shreveport, Louisiana.

Since the Shreveport area does not have the local expertise necessary to centrally manage the NC3 system, the Air Force would need to entice leaders and specialists to move to the Shreveport area. The incentives to move to Louisiana would need to be able to overcome several issues with the location. First, CNBC ranks Louisiana as the sixth worst state to live in 2015, citing health and crime as its primary weaknesses.[17] Second, Louisiana's education system ranks 47th in the United States.[18] Finally, Louisiana is ranked the fifth most dangerous state in America.[19] Each of these statistics are typically considered by people considering occupational relocation, and the poor ranking bodes ill for enticing personnel to relocate to Barksdale AFB. Ultimately, centralizing NC3 system management at the service level, specifically the Air Force, could result in lopsided prioritization due to institutional inertia, as well as personnel problems associated with the AF-selected location for centralization.

United States Strategic Command (USSTRATCOM), at the joint military level, would be the next logical step above the service level. USSTRATCOM's mission is to conduct global operations in coordination with other combatant commands, services, and appropriate U.S. Government agencies to deter and detect strategic attacks against the United States, its allies, and partners and be prepared to defend the Nation as directed.[20] USSTRATCOM's top five priorities are to: deter strategic attack against the United States; provide a safe, secure, and effective nuclear deterrent force; assure allies; build enduring relationships with partner organizations to confront the broad range of global challenges; and address challenges in space.[21] USSTRATCOM executes operations using forces from the four services. In simple terms, USSTRATCOM is the United States' strategic warfighter responsible for operating all U.S. nuclear forces.

Centralizing NC3 system management in USSTRATCOM, likely as a sub-unified command similar to U.S. Cyber Command, could result in unintended consequences. As a combatant command, USSTRATCOM employs the forces that military services organize, train, and equip. In essence, combatant commands are service users, not service providers. The NC3 system provides a communications service required by many services and agencies, not just USSTRATCOM. Placing USSTRATCOM as the NC3 system manager could greatly exacerbate the issues resulting from institutional inertia, ultimately resulting in a USSTRATCOM-centric implementation of the NC3 capability. Although these issues can likely be overcome and USSTRATCOM could manage the NC3 system, there remain two main reasons USSTRATCOM should not be the centralized NC3 manager: First, the combatant command/military service relationship is such that military services provide the forces and services necessary for combatant commands to execute operations; and second, although USSTRATCOM could mitigate many of the issues due to the current fragmented management of the NC3 system, another organization is the best solution.

The Defense Information Systems Agency (DISA), formerly the Defense Communications Agency, is the best fit to manage the entire U.S. NC3 system. DISA is a DoD combat support agency that provides communications support to the President, Vice President, Secretary of Defense, the combatant commands, and the military services. According to DISA's mission statement, DISA "provides, operates, and assures command and control, information sharing capabilities, and a globally accessible enterprise information infrastructure in direct support to joint warfighters, national level leaders, and other mission and coalition partners across the full spectrum of operations."[22]

In DISA's *Strategic Plan 2015-2020,* the agency's Director stated, "The Joint Information Environment remains the cornerstone of the [DoD's] future – providing a secure information framework from which our national senior leaders and joint force commanders, command and control forces that deliver responsive, decisive actions from any device; anytime anywhere." DISA is a future-conscious agency focused on "remain[ing] purposeful in planning, acquisition, operations, and execution." Furthermore, the DISA Director added, "We will be aggressive in our pursuit of efficiency and effectiveness… and proactively evolve capability requirements to meet operational needs."[23] A potentially valuable aspect of transitioning NC3 system management to DISA is that DISA is a communications-centric organization; and communications, although not the sole aspect of the NC3 system, certainly is the essence of the system.

DISA's organizational structure is specifically designed to enhance functional efficiency. In 2011, DISA relocated its 4,500 military and civilian employees and supporting contractors to Fort Meade, Maryland, into a consolidated complex. Thus, without further structural adjustment, DISA has already centralized its leadership. Additionally, the DISA Director has already been assigned the task of being the NC3 system Engineer for the Department of Defense. Transitioning the entire U.S. NC3 system to DISA, under the direct control of DISA's Director, is the next intuitive step and would correct fragmented management- and functional inefficiency-related issues.

Moreover, DISA is organized to manage the systems under its responsibility from inception to end of life. DISA's organizational structure includes a cadre of specialists at every stage of a system's lifecycle. DISA's manpower includes acquisitions professionals, end-user representatives, communications specialists, cybersecurity specialists, information warfare specialists, resource managers, and more working together to provide communications capabilities to the DoD. Although the U.S. NC3 system includes many terrestrial-, air-, and space-based elements, DISA is capable of absorbing the additional responsibility of owning the NC3 system and providing NC3 capabilities with far less personnel increase than any other organization in the DoD. DISA's "cradle to grave" management of systems begins in the Development and Business Center, which includes directorates responsible for engineering and solutions analysis, test and evaluation, infrastructure development, and services development. The Implementation and Sustainment Center sustains each system's infrastructure

through end of life. Working together, these two centers ensure that the communications network DISA provides meets all customer requirements. Due to the inherent dual nature of NC3 system elements, the additional responsibility of the NC3 system creates less work for DISA than it appears.

Given the ultimate objectives of and the benefits that accrue from centralization, DISA appears to be the best overall candidate as the management hub for the NC3 system.

RESPONSE TO POTENTIAL OBJECTIONS

Advocating change is difficult, and the natural tendency of human beings is to resist change. This is so for many reasons, to include loss of autonomy or control, fear of the unknown, creation of extra work, and the very real threat that jobs can be lost.[24] Hence, objections to centralizing management of the NC3 system under DISA may include the following points.

- Centralizing management leads to group think and the tyranny of the majority. Simply centralizing management of the NC3 system will not solve all the issues associated with the current split-management. The claim that centralized management unifies stakeholders and increases information sharing is challenged by those who argue against centralized management. This argument claims that centralizing management merely centralizes all the fight within a single organization which could lead to group think[25] and the tyranny of the majority.[26] In point of fact, this can occur at any level, in any organization. Every organization should take steps to counter group think and eradicate the tyranny of the majority, whether management is centralized or not. These issues can affect groups of all sizes in many structures and are certainly not limited to the centralized management structure.

Centralizing NC3 system management will be a herculean effort requiring leaders across the DoD to accomplish the reorganization with no interruption to NC3 capability. Since centralized control and decentralized execution is a foundational concept within current joint and service doctrine,[27] relinquishing control of the disparate systems and elements of the NC3 system to DISA could be a difficult pill for services and agencies to swallow, but that does not negate that centralizing management, with DISA as lead, is the best way to improve NC3 system management.

- DISA does not know enough about the NC3 system to manage it. The vast majority of communication systems classified as NC3 systems are dual-use and only partially support nuclear operations. DISA's responsibilities span the gamut of U.S. communications capabilities, to include NC3 systems. Hence, although DISA is primarily responsible for the bulk of the communications systems and networks not classified as part of the NC3 system, this does not mean DISA is not well versed in NC3 issues and requirements. DISA's current NC3 system responsibilities include

management of the Minimum Essential Emergency Communications Network (MEECN).[28] MEECN is a highly survivable communications capability which transmits messages and establishes crisis conferences with the President, Vice President, Secretary of Defense, and the Chairman of the Joint Chiefs of Staff to the combatant commands and to deployed U.S. nuclear forces. DISA provides architectures, systems engineering, analyses, and assessments to support the needs of national leadership.

Nevertheless, it is also true that the DISA Director is the NC3 System Engineer; and DISA's Joint Systems Engineering and Integration Office supports NC3 governing services and agencies by providing NC3 enterprise engineering support. DISA already contains vast knowledge and experience in NC3, perhaps more than any single service or agency in the world. Placing NC3 system management responsibilities in DISA would provide the United States with an effective NC3 system in the most efficient way possible.

- Allowing DISA to dictate NC3 capabilities to services and agencies creates more, not less, bureaucracy.

In point of fact, however, DISA already provides a full spectrum of communications services. U.S. combatant commands set communications requirements and DISA, through the acquisition process, ensures the communications capability provided meets the requirements. This would be no different if DISA were charged with management of the NC3 system: the President of the United States would publish a Presidential Policy Document to the effect that communications in support of nuclear operations will be assured and reliable; DoD, the Combatant Commands, and the services would define, in concrete terms, what "assured" and "reliable" mean. DISA would receive specific parameters that define threshold and objective values, and would then set out to produce the best possible capability with available resources.

- A reorganization of the magnitude contemplated here would be prohibitively expensive.

Admittedly, consolidating all NC3 elements into a single NC3 system and centralizing its management under a single organization would incur significant initial costs. Nevertheless, viewing the NC3 system as a whole and amalgamating NC3 system costs now spread across many separate organizational budgets, centralization to DISA may well be not only the most effective solution but also the least expensive of the three options above and amortized over time, may even be less expensive than the status quo.

CONCLUSION

In 2009, President Barack Obama stated that although the United States is taking steps to reduce the role of nuclear weapons in its national security strategy, it would take patience and time. "Make no mistake:" the President stated, "As long as [nuclear] weapons exist, the United States will maintain a safe, secure,

and effective arsenal to deter any adversary, and guarantee that defense to our allies."[29] Accomplishing this strategic aim requires the assured viability of the NC3 system into and beyond the foreseeable future. System consolidation will not be easy. It will require, among other things, a comprehensive personnel management strategy, as well as strategies for portfolio management and phased implementation. Indeed, completing a transition of the magnitude required to encompass the entire U.S. NC3 system could take several years and require synchronizing key milestones across multiple systems and elements. Every service and agency involved would need to understand exactly what is moving, when it is moving, and at what point authority is transferred.

However, all such challenges are manifestly subordinate to the fact that U.S. nuclear deterrence and assurance is threatened if U.S. adversaries and allies believe the President of the United States might not be able to direct the launch of a nuclear weapon at any time, from anywhere, under any circumstance. Studies announcing the United States' fragmented management of NC3 systems, though intended to refocus efforts to improve management, ultimately risk U.S. nuclear deterrence capabilities. Now that U.S. adversaries are aware of management issues potentially affecting the President's ability to direct U.S. nuclear forces, the U.S. must overtly address these issues. Identifying DISA as the single lead for the U.S. NC3 system would signal to U.S. adversaries and allies that the United States takes its nuclear deterrence and assurance missions seriously.

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BIOGRAPHY

Lt Col Craig S. Roblyer, Sr., is a Countering Weapons of Mass Destruction (CWMD) Planner at the Defense Threat Reduction Agency, Fort Belvoir, VA. He holds a M.S. in Weapons of Mass Destruction Studies from Missouri State University. He was previously assigned as the Chief of Air Force Nuclear Command and Control Communications (NC3) Policy for the Deputy Chief of Staff for Strategic Deterrence and Nuclear Integration (AF/A10) at the Pentagon, and as an Emergency Actions Officer on the National Airborne Operations Center (NAOC) at Offutt AFB, NE. Lt Col Roblyer is a National Defense University Countering Weapons of Mass Destruction Fellow.
craig.s.roblyer2.mil@mail.mil

APPLICABILITY OF NUCLEAR DETERRENCE THEORY TO CYBER ATTACK DETERRENCE

George Núñez
National Defense University

INTRODUCTION

Some thoughtful observers have opined that a "cyber Pearl Harbor"[1] is not only possible, but imminent. Recent intrusions into government and private computer networks reinforce this belief and underscore U.S. cyber vulnerabilities and raise pressing questions as to how, if at all, the cyber threat may be deterred. However, while "cyber" may constitute a relatively new threat concept, "deterrence" does not. Deterrence has been part of national security calculus since time immemorial. However, the word itself really did not become part of the popular vocabulary until the advent of nuclear weapons—and the role it has played from that time and continues to play today is central to all nuclear discourse in the West. Since that time, the United States has worked through the complex and "grim logic of deterrence" by identifying what to deter, what threats to issue, and how to back up those threats. Indeed, well-known nuclear theorist Kenneth Waltz has gone as far as to say that "No one has discovered how to use nuclear weapons other than for deterrence."[2] As a result, the past seven decades of the nuclear age have yielded important lessons not only about the nature of nuclear weapons, but also about the theory of deterrence itself. Hence, it is worth considering whether and, if so, to what degree, those lessons may be transferrable to the new domain of cyber warfare.

TWO COMPETING APPROACHES TO NUCLEAR DETERRENCE

The United States' nuclear deterrence doctrine began with the assumption of reasonable and rational adversaries.[3] From this assumption flowed the conclusion that nuclear opponents will behave predictably when their values face credible risks. This conclusion, in turn, gave rise to two principal schools of thought with respect to nuclear deterrence:

- On the one hand, nuclear theorist Thomas Schelling argued that a "stable balance of terror" was possible among mutually vulnerable actors because rational and reasonable opponents would prudently temper their use of nuclear weapons. Schelling proposed that forces contributing to mutual capabilities for nuclear retaliation would increase stability, while forces contributing to the "reciprocal fear of surprise attack" would increase instability.[4] Accordingly, he proposed that deterrence would function with a relatively small number of U.S. nuclear weapons that continued to threaten Soviet cities in the event of a nuclear attack against the United States. Schelling concluded that empirical evidence was not essential as long as, "You can sit in your armchair and try to predict how people will behave by

asking how you would behave if you had your wits about you."[5] Hence, the "stable balance of terror" approach emphasized prescriptions for the composition of U.S. nuclear forces over attaining significant empirical evidence about potential opponents.

- On the other hand, and precisely because of uncertainties about adversary political goals, military strength relative to U.S. and NATO forces, and cost/risk tolerance, nuclear theorist Herman Kahn argued not for a balance of terror, but rather for significant quantitative nuclear advantages for the U.S. "For Kahn, the causes of nuclear war included the potential for a deliberate, calculated decision on the part of the Soviet leadership to advance dearly-held goals or to change the course of an intolerable situation, *despite the attendant uncertainties* of escalation."[6] In Kahn's view, a nuanced understanding of opponent values and decision-making increased the likelihood that deterrence could function by design. Kahn advocated for offensive and defensive nuclear advantages in part because essential empirical evidence may not be obtainable, and information obtained may be misleading.

Kahn's "U.S. advantage" approach proposed seeking greater certainty for deterrence to function; whereas, Schelling's "balance of terror" theory concluded that some uncertainty contributed to achieving deterrence.

Effectively applying the means to achieve deterrence in both approaches depended on deducing and then targeting the opponent's *values*. As ethereal as that might sound, it is actually a good deal more substantive than another approach that the U.S. has frequently tried with limited success, to wit: "winning hearts and minds"; for the "values" Schelling and Kahn were referring to could be translated into hard targets. Schelling argued that targeting Soviet cities and industry was sufficient to achieve deterrence, while Kahn argued that deterrence required threatening many Soviet targets, including nuclear forces, and significant damage-limitation capabilities to deny the effects of Soviet weapons.[7] Kahn's very expensive "U.S. advantage" approach placed damage-limitation and the United States' ability to deter against a nuclear attack in direct proportion: As one increased, so did the other (along with the cost). Schelling's less expensive "balance of terror" approach assumed that damage limitation eroded the United States' ability to deter nuclear aggression because an opponent could fear that his nuclear reprisals might not be effective, and might, as a result, feel emboldened to attempt a preemptive nuclear attack. Nevertheless, both approaches sought to threaten what they believed were the Soviet's greatest values.

Kahn and Schelling also disagreed on how to best establish U.S. deterrence credibility. For Schelling, the basis of credibility was the Soviet fear of a possible uncontrolled U.S. nuclear escalation: a "threat that leaves something to chance."[8] Conversely, Kahn argued that the basis of credibility was the Soviet belief that the United States could deliberately initiate a nuclear escalation to protect vital interests: a "threat that leaves little to chance."[9] From these conclusions followed diverging views on what may best reestablish deterrence after an

initial deterrence failure. Schelling proposed U.S. capabilities for graduated steps to reinforce Soviet fears of an uncontrolled escalation. Kahn proposed U.S. capabilities that could limit damage to the United States to reinforce Soviet beliefs that a deliberate U.S. nuclear escalation was possible. Notwithstanding disagreements between Schelling and Kahn on the means of deterrence and the basis of credibility, both theorists argued for secure offensive nuclear weapons to pose a retaliatory threat, and both thought deeply on how to re-establish deterrence in case deterrence failed.

These approaches influenced U.S. nuclear deterrence strategy and continue influencing ongoing deterrence debates. However, Cold War U.S. policies most nearly reflect Schelling's concepts; and the use (and inadvertent misuse) of his theory's lexicon endures today. However, that does not mean that his concepts are impervious to criticism. Some analysts argue that the selection of the stable "balance of terror" approach—a concept never recognized by Soviet leaders—is indicative of the U.S. preferences for *technical* solutions to complex problems.[10] Schelling's concepts were appealing in part because of his conclusion that a small U.S. nuclear arsenal, without costly defensive and protective measures, is suitable for deterrence to function predictably. Schelling's conclusions lend themselves to quantifying the type and number of nuclear weapons with greater precision—something that appealed to officials formulating defense budgets—than Kahn's advocacy of considerable offensive and defensive advantages. Schelling's easily understood prescriptions for the composition and disposition of the U.S. nuclear arsenal also gave the appearance of scientific solutions to a complex problem. Conversely, Kahn's approach pointed to an enduring and costly security competition.

Because, for much of the Cold War, U.S. deterrence policy relied on intuitively ascribing values to opponents vice gathering empirical evidence "to ensure that the Soviet leadership would be considered predictably deterrable"[11], the United States fielded few defensive and protective measures. Post-Cold War revelations of Soviet intentions to employ a large number of chemical and nuclear weapons early on in a war with NATO and then fight through the lingering effects of these weapons undermines conclusions that knowledge of an opponent's values may be gleaned from knowledge of one's own. These revelations, along with the nuclear weapon acquisition efforts of other actors, coupled with maturing anti-ballistic missile technology, have since contributed to the decision to field a national missile defense capability of the very kind that many U.S. leaders eschewed during the Cold War.

GETTING CLEAR ABOUT WHAT CONSTITUTES A "CYBER ATTACK"

Cyber deterrence is an extremely broad concept that lacks canonical legal definitions within the U.S. government and insufficient foreign consensus on how international law and the law of armed conflict apply to cyberspace. Nevertheless, clearly identifying *what* action the United States should aim to deter remains essential for cyber warfare, just as it does for nuclear warfare. As with nuclear deterrence, cyber deterrence must first focus attention on weapons

and activities that can cause catastrophic physical damage to the United States instead of the technologically infeasible objective of deterring all misbehavior across the entire cyber domain.

Distinguishing cyber attacks from other, sometimes related, cyber activities, can help to narrow the broad concept of cyber deterrence. While a widely approved cyber attack definition would be optimal for creating a deterrence strategy and then attempting to communicate specific threats, an internationally accepted definition appears unlikely in the foreseeable future. In the interim, a U.S. legal opinion and an internationally proposed definition of a cyber attack can suffice for a cyber attack deterrence strategy. The "United States has for a long time taken the position that the inherent right of self-defense potentially applies against *any* illegal use of force."[12] Following from this enduring U.S. legal opinion, the State Department publically identified in 2012 the United States' position on cyber attacks to be that "cyber activities that proximately result in death, injury, or significant destruction would likely be viewed as a use of force."[13] This U.S. position indicates that characterizing a cyber action as an armed attack depends on an evaluation of the action's effects (or the most likely effects in the event of an intercepted action), the action's context, and the intent of the actor(s). Accordingly, military responses to a cyber attack are subject to evaluation under the traditional just war rubric of *jus in bello,* requiring compliance with principles such as immediacy, military necessity, distinction, and proportionality.

The 2015 Defense Cyber Strategy lists four possible effects of a cyber attack, which do not fully conform to the 2012 U.S. position: "While cyber attacks are assessed on a case-by-case and fact-specific basis by the President and the U.S. national security team, significant consequences may include loss of life [and] significant damage to property."[14] However, the strategy's description expands the 2012 U.S. position by including "serious adverse U.S. foreign policy consequences or serious economic impact on the United States" as possible results of cyber attacks.

Without deaths, injuries or significant physical damage, characterizing a cyber action as an armed attack would be inconsistent with the 2012 U.S. position and some foreign legal opinions on the applicability of international law to cyberspace. International legal experts reviewing the applicability of international law to cyber warfare have concluded "that any use of force that injures or kills persons or damages or destroys property would satisfy the scale and effects requirement [of an armed attack]."[15] The NATO Cooperative Cyber Defense Centre of Excellence (CCD COE), which provides independent academic research for cyber defense issues, devised the preceding legal view to inform policy-makers. To illustrate this definition, the CCD COE commonly uses the 2009 cyber attack against Iranian nuclear facilities as an example for discussing legal and illegal uses of force under international law. The CCD COE characterizes the 2009 cyber attack against Iran as an armed attack due to the reported physical damage to 1,000 uranium enrichment centrifuges.[16] In this case, a claim of self-defense and an Iranian response that included the use force would have likely been consistent with international law.

Preventing death, injury, and significant physical damage to the United States must be the strategic purpose of cyber deterrence. This purpose emphasizes preventing the effects of the most dangerous actions against the nation's essential cyber-dependent infrastructure over deterring many other cyber activities. Thus, a sound cyber deterrence policy may not deter every hacker that attacks a public interest–just as a sound nuclear deterrence policy does not ensure against every armed attack. However, a properly oriented cyber deterrence policy could, in fact, be expected to give pause to a potential state adversary that contemplated, for example:

- opening a dam above a populated area to cause physical destruction;
- triggering a nuclear reactor meltdown;
- disabling air traffic control to cause crashes; or
- disabling water treatment or power generation and distribution to cause loss of life.

The 2013 *Tallinn Manual* defines a cyber attack as "a cyber operation, whether offensive or defensive, that is reasonably expected to cause injury or death to persons or damage or destruction to objects."[17] Although this is an academic and non-binding definition, use of the *Tallinn Manual* adds coherence to cyber attack deterrence logic by defining the concept in a relatively narrow way. In this narrow but important sense, the United States has not suffered a cyber attack, just as it has not suffered a nuclear attack. Although computer network intrusions point out vulnerabilities that an actor may later exploit to commit a cyber attack, compromised U.S. networks have not proximately caused injuries, deaths, or physical destruction. Recent intrusions into U.S. networks are cases of espionage, intellectual property theft, and others crimes. Cyber actions that do not meet the international law threshold for the use of force warrant law enforcement and other responses vice the use of military force.

NUCLEAR AND CYBER DETERRENCE: POSSIBLE POINTS OF INTERSECTION

LESSON 1: KNOWING ONE'S OPPONENTS

There is no substitute for knowledge of the adversary's mind.[18] While it is impossible to determine with certainty how actors will behave during a crisis, empirical evidence can help with deducing how an opponent may respond to deterrence measures. During the Cold War, competing nuclear deterrence approaches diverged on the question of how much empirical evidence was required to predict how opponents would behave. Today, the detection of tens of thousands of cyber intrusions into U.S. networks each year provides a wealth of empirical evidence that can overwhelm the intelligence community but can also identify actors and their unique behaviors. Cataloging this information within a deterrence framework may, in fact, enable informed decisions about each cyber threat.

Knowledge of a potential opponent's goals, perceptions, and cost/risk tolerance can help to predict how that opponent will respond to deterrence measures. Assuming that an aggressor with a low cost/risk tolerance is deterrable without an analysis of the actor's goals and perceptions may risk misplaced faith in a strategy. On the other hand, an aggressor with a very high cost/risk tolerance may not appear susceptible to deterrence, but closer examination of the actor may reveal values that are vulnerable to punishment and denial measures. Empirical evidence may also indicate that an actor is not deterrable by available or acceptable means. In each case, assessing the prospects for achieving cyber deterrence begins with viewing the situation from the threat's perspective.

Maximizing the chances that cyber deterrence can function requires sustained knowledge of the adversary's mind. "Deciphering an opponent's perceptions and decision making is a daily cumulative business, not an improvised test of nerve in the course of brief crises."[19] The efforts needed to predict the behavior of opponents have increased with the emergence of non-state cyber actors, who may have goals, perceptions, and cost/risk tolerances that are more difficult to discern and target than previous state actor threats. In light of the scale and scope of cyber threats and the corresponding intelligence-gathering challenge, discussing cyber attacker characteristics can inform debates on how much the United States must know about opponents for cyber attack deterrence to function reliably.

Because cyberspace's open design framework promotes ease of use over security, the offense has inherent advantages over the defense. Absent an unlikely, costly, and massive redesign of the internet, offensive means will continue to trump defensive means for the foreseeable future. In fact, some authors have noted the futility of defensive means. "[E]very state that is concerned about the cyber realm from a global security perspective is equally deficient and vulnerable to offensive [cyber] attack; therefore, defensive cyber systems are likely to remain relatively impotent."[20] The costs of fielding cyber weapons is considerably less than conventional weapons, so barriers to entry are low, while offensive cyber innovations continue to outpace reactive defensive measures. Accordingly, many actors find cyber weapons appealing and are pursuing their development. Some state actors, such as Russia, China, and Iran, are already deploying them (despite strident denials) along with other actors, such as North Korea and the so-called Islamic State of Iraq and the Levant (ISIL).[21] However, the combination of a target's cyber vulnerabilities and an aggressor's ability to conduct a cyber attack does not necessarily mean that a cyber attack is imminent any more than, during the Cold War, that the combination of nuclear vulnerabilities and an aggressor's ability to wage nuclear war necessarily meant that a nuclear attack was imminent.

Not every actor with a cyber weapon is a threat, much less an immediate threat. Most states with significant cyber capabilities are U.S. allies and partners. However, the United States *is* vulnerable to at least two major state cyber actors and a number of non-state actors that have restrained themselves from conducting cyber attacks, presumably because the risks of an attack appeared

to outweigh the possible benefits. Erik Gartzke has noted a common fallacy among arguments that link the opportunities to conduct cyber attacks and cyber attack outcomes without addressing the companion logic of the ends sought by attackers.[22] Without considering the reasonable benefits that a cyber attacker can gain in pursuit of his goals, a defender may fall prey to a false dilemma—either remedying all possible vulnerabilities or suffering the imminent consequences of cyber attacks. Nevertheless, one can make a case that alternatives to either accepting cyber vulnerabilities or seeking cyber invulnerability are possible. One plausible alternative is creating a "daunting cyber-lethal offensive capability—not so much to actually use it, but rather to instill the fear of it being used."[23]

Like other uses of force, cyber attacks entail cost/risk calculations. For example, cyber attackers may find that their cyber weapon of choice is, in reality, a one-time use weapon that also invites a significant risk of retaliation. The same offense-over-defense dynamic that allowed the exploitation of a vulnerability entails the possibility of in-kind reprisals. However, as indicated in the 2011 *International Strategy for Cyberspace*, cyber attack responses need not be limited to in-kind retaliation.[24] Exercising the right of self-defense allows for a wide range of options against attackers and complicit third parties, to include: applying domestic law enforcement; responding short of force with diplomatic and economic tools; retaliating in-kind; and retaliating with force in other domains. In any case, defense planners must bear in mind that cyber attacks, just like nuclear attacks, are not ends in and of themselves; they are instrumental activities intended to achieve political aims, and they must be addressed accordingly.

Creating and maintaining an accurate global map of cyber threats is challenging, but this intelligence-gathering task is not impossible. Evidence collected from cyber intrusions, public and private cyber forensics efforts, and the political context of cyber actions offers a wealth of information. Traditional intelligence tools, such as pattern analysis, and new military concepts such as "attack the [human] network,"[25] exploit available information to predict behavior and identify direct and indirect ties from one actor to a collection of other actors.

As was the case with nuclear testing, observation of adversary cyber weapons tests can aid significantly in the creation of a global cyber threat map and cyber actor profiles. Cyber weapons are tailor-made to exploit specific and sometimes fleeting vulnerabilities, which then allow for specific effects within computer systems.

Cyber attackers commonly select environments that most reflect the intended target but present the least risk of retaliation. For example, a threat may choose to test a cyber weapon in a Sub-Saharan country in which cellular phone and internet use and system architectures are representative of the intended target, but the attacked "test target" has insufficient ability to detect, counter, attribute, and retaliate against the cyber attacker. "Live fire" cyber weapon tests allow a cyber actor to assess a weapon's effects and refine subsequent versions, but tests also expose the actor to detection and countermeasures from third parties. The scope and sophistication of clandestine cyber weapon testing may also

indicate how a cyber threat sees its own vulnerability to detection, denial, and punishment. Detecting cyber weapon tests and mapping cyber threats contribute to predictive cyber actor profiles.

Asymmetry, in terms of arraying one's strengths against an opponent's weakness, is not a novel warfare concept; the United States dealt with many asymmetries during the Cold War era by discerning how to reduce, deny, and deter the use of adversary asymmetric advantages. For example, overwhelming Soviet conventional military power was arrayed against a smaller NATO force for most the Cold War, to which an unambiguous nuclear declaratory policy appears to have tempered Soviet ambitions. Discussing cyber asymmetry and vulnerabilities without discussing how an attacker can exploit the effects of a cyber attack presents an incomplete picture. If a cyber attacker cannot exploit the physical damage caused by a cyber weapon and re-use of the weapon is unlikely, then the threat of cyber asymmetry is probably overstated (because—again—neither nuclear nor cyber attacks are ends in and of themselves). In fact, actors that are most able to exploit the effects of a cyber attack are those with substantive military power, which already poses threats in other domains. The 2007 computer network disruptions targeting Estonia and the 2009 cyber attack against Iran are examples of cyber effects that create opportunities for other instruments of power to exploit. Cyber victims that cannot remedy or immediately deny exploited vulnerabilities after detecting the use of a cyber weapon are likely facing threats that are more physically pressing than a cyber attack. Conversely, cyber attackers that lack strength in other domains may be the most vulnerable to denial and reprisal, thus likely tempering their desire to use a cyber weapon.

The challenges of exploiting cyber attack effects are similar to the failure of using chemical weapons to attain strategic ends. During the twentieth century, states employed chemical weapons in bids to achieve strategic ends when other means had failed. During World War I, both the Triple Entente and the Central Powers employed chemical weapons, which yielded tactical gains, but none of the belligerents could field enough military power to exploit fleeting opportunities and then break the stalemate of trench warfare. Chemical weapons also created temporary tactical gains that did not achieve strategic ends during the Italian-Ethiopian and Iran-Iraq Wars. Both the Italian and Iraqi regimes found themselves ill-equipped to exploit the effects of chemical weapons against their Ethiopian and Iranian targets. Similarly, cyber attacks may cost many lives, however, cyber weapons have not yet achieved strategic ends by themselves.

Attribution in cyberspace is undoubtedly harder than detecting and attributing the detonation of a nuclear weapon. However, cyber attack attribution is not impossible. Many commercial cybersecurity entities have confidently and publically attributed some of the most conspicuous intrusions into U.S. networks. Overcoming false flagging, proxy servers, and other attempts to conceal an attacker's identity requires substantive specialization and time. However, delayed attribution with varying degrees of confidence still carries risks for cyber attackers. Just as it would be unreasonable to conclude that classified cyber profiles are not available, the growing demand for commercial cyber forensics

very likely has a parallel government effort. The success of "nongovernment groups and individuals in building thorough profiles of malicious cyber actors" has identified cyber actors in the physical domain.[26] Moreover, cyber attackers, themselves, face attribution quandaries. To elicit compliance from cyber attack threats, attackers may be compelled to disclose their identity and information about a cyber weapon, without which the target may ignore the threat or may simply be ignorant of the threat. At the same time, disclosing information forewarns the target and allows for remedies to counter vulnerabilities that a cyber weapon requires to create the intended effects. In cases where threats are not issued or perceived, anonymity reduces or eliminates the credit that the attacker may desire. Most forms of political conflict encourage disclosing an initiator's identity—coercion requires attribution.[27]

LESSON 2: BOTH SIDES OF CREDIBILITY

Both targets and aggressors seek to pose credible threats. An actor seeking to deter an aggressor must create, communicate, and then preserve the credibility of a deterrent threat. If an aggressor perceives that his values are defenseless against the target's punishment capabilities, then the target's deterrence effort is more likely to be effective. Defenses that can limit damage increase deterrence credibility by preserving the target's freedom of action and bolstering the will to retaliate against an aggressor. Likewise, an aggressor also seeks credibility. "For threats or demands to prove effective, targets must believe both that an attack is likely to follow from noncompliance and that the attack is destined to inflict unacceptable harm."[28] Aggressors that lack the means to bypass a target's denial measures and are subject to intolerable retaliation are less likely to wield credible threats. Both actors that seek to deter aggression and actors that seek to intimidate or coerce strive to make credible threats.

Herman Kahn observed that the "most convincing way to look willing is to be willing." This observation applies to actors on both sides of a deterrence equation. Yet cyber opponents that make credible threats to use cyber weapons against the United States incur significant risk. Both the risk of punishment, even if achieving confident attribution takes months or years, and the risk of proactive remedies to the vulnerabilities that are essential for the cyber weapon's effectiveness, present challenges for attackers. Moreover, the greater the opponent's credibility, the more likely that the opponent's cyber threat may meet the threshold for self-defense and then allow the United States to use preemptive force.

"No [cyber] attack or demonstration has provided images and dread comparable to that of Hiroshima and Nagasaki."[29] David Elliot's 2011 observations on the inadequacies of cyber attack demonstrations could have gone further by stating that, aside from the physical damage caused by the Stuxnet cyber attack, *no* cyber attack has caused deaths and catastrophic physical damage. Advocacy for conducting a cyber attack demonstration follows from premises that demand in-kind cyber preemptive or retaliatory attacks. However, effective cyber deterrence need not require the demonstration of a cyber weapon. Declaratory policy may

suffice, especially when stating what additional means of cyber punishment and denial are available and can reinforce credibility without disclosing specific cyber weapon attributes. Greater challenges to deterrent threats may come from an opponent who calls a bluff due to a perceived imbalance between U.S. stakes and risks or when policy decisions inadvertently erode credibility.

In the context of a nuclear confrontation with China over Taiwan, a Chinese general reportedly observed that the United States would not trade Los Angeles for Taipei.[30] This commonly attributed observation is illustrative of how perceptions of credibility can erode when an opponent sees an imbalance between one's stakes and risks. Likewise, unimplemented threats can weaken deterrence credibility. Without matching rhetoric with action, an opponent may have to guess what constitutes a truly unacceptable act. "Face," Schelling wrote, is not "a frivolous asset to preserve" but "one of the few things worth fighting over," not only because it preserves credibility, but also because it prevents dangerous future contingencies from happening.[31]

LESSON 3: DETERRENCE FAILURE IS POSSIBLE

That deterrence failure is possible is a mild understatement, because deterrence success cannot ultimately be proven: only deterrence failure can. Hence, believing with certainty that deterrence will predictably function risks strategic surprise. Despite amassing valuable empirical evidence and fielding credible denial and punishment means, one cannot logically dismiss the possibility that deterrence can unexpectedly fail. Moreover, adversaries that the U.S. counts upon being "rational" may, in fact, *be* "rational", but only within the context of their own internal rationality and not within the context of a rationality shared by the United States. During Cold War confrontations, some widely accepted nuclear deterrence concepts were found wanting. Accordingly, possessing punishment means in concert with active and passive defenses and protection measures is prudent in case deterrence fails.

When a security crisis occurs, "surprises frequently are in store for those who believe that a foe's basic rationality permits confident prediction of its behavior."[32] Deterrence may fail for a wide variety of reasons such as miscalculations of what opponents most value and misperceptions of how opponent leaders make decisions. Some actors may be less susceptible to deterrence measures than they appear, and the United States may not be aware of other threatening actors. Piecemeal use of punishment and denial measures against violent millenarian groups similar to Japan's Aum Shinrikyo, which actively sought to preserve anonymity, may fail. Nevertheless, actors that are rational and reasonable still have values that one can target and goals that one can deny.

During a crisis, antagonists often misunderstand opponent intentions, which a confrontation—nuclear or cyber—could aggravate by disrupting the established means for conveying and acknowledging messages. Graham Allison noted that after more than 50 years, the highly-studied Cuban Missile Crisis continues to offer important contemporary lessons. The violation of the "rules of the precarious

[Cold War] status quo"[33] was a U.S. surprise in part due to overlooked Soviet goals and perceptions. A central question was "why did the Soviets place missiles armed with nuclear weapons on Cuba?" Greater analysis of the Soviet leadership's goals may have contributed to answering this question during the crisis—or before the secret dispatch of Soviet nuclear weapons to Cuba. One notable Soviet goal of the decision to emplace missiles in Cuba apparently not perceived by U.S. leaders was Nikita Khrushchev's personal "desire to give the Americans 'a little of their own medicine'"[34]—the United States having placed nuclear missiles in Turkey.

Conflicts initiated by non-nuclear weapon states against nuclear weapon states also highlight the need to temper confidence in the predictability of deterrence. China's 1950 intervention in the Korean War, the 1973 Yom Kippur War, the 1982 Falklands War, and the 1991 Persian Gulf War are some examples. In each of these cases, states with nuclear weapons were unable to deter non-nuclear weapon states from using military force because they were willing to endure varying risks of nuclear reprisals—or else the non-nuclear weapon states proceeded on the assumption that the respective conflict was not one likely to assume a nuclear dimension. Moreover, non-nuclear weapon states were unwilling to accept the costs of not using military force. During the Korean War, a senior Chinese official went as far as to say, "They may even drop atomic bombs on us. What then? They may kill a few million people."[35] In these four cases, the relatively weaker state's use of force was arguably a surprise for the stronger state because the former's risks appeared intolerable to the latter. Passive and active defenses and resilience, providing an effective ability to recover from an attack—whether nuclear or cyber—could bolster U.S. willingness to punish and may mitigate perceptions of an imbalance between U.S. and opponent stakes.

POTENTIAL CHALLENGES TO THIS ANALOGICAL APPROACH

The present author makes no claim of a perfect one-to-one correspondence between nuclear and cyber deterrence; but then again, no such perfect analogy is necessary. The very nature of analogical reasoning holds that the things being compared are merely things with noteworthy correspondences—not identical twins. In fact, nuclear and cyber deterrence have substantive differences that one must take equal care to note. For example:

- The low-cost and ubiquity of cyber technology is a fundamental difference which, when compared to the bipolar Cold War, presents a significant challenge due to the number of state and non-state actors that may be or may become cyber threats.
- The inherent commercial interests and roles in cyber technology limit exclusive state control over developments in cyberspace.
- With the technology's competitive and rapid evolution and the commercial role in sustaining cyber infrastructure, minor actors that warranted little attention during the Cold War can now influence vital national interests. (Of note, nearly 90% of the Defense Department's cyber functions rely on access to commercial cyber infrastructure.)

The reliance of modern life on daily cyber activity for essential functions creates a significant interest and awareness in the technology, whereas nuclear weapons continue to be generally abstract threats to laymen. Virtual intrusions and denials of internet access quickly gain public attention and appear more tangible than nuclear deterrence decisions. While states may brandish nuclear weapons, cyber threats seek anonymity to preserve cyber vulnerabilities and the effectiveness of cyber weapons. Additionally, the availability of empirical evidence on cyber activities provides opportunities to test deterrence concepts to a degree not possible (or even desired) during the Cold War.

Arguments concluding that attribution and asymmetry make cyber deterrence improbable should not be dismissed out of hand. However, a close examination of these arguments reveals key explanatory omissions. These arguments tend to emphasize U.S. cyber vulnerabilities, while failing to explain the absence of successful cyber attacks against the United States and identify the benefits that cyber attacks may provide an attacker. Given the breadth of U.S. vulnerabilities and the number of physical attacks[36] against the United States since the end of the Cold War, one can reasonably ask why the United States has not suffered many cyber attacks in the sense defined above. This is a particularly important matter to address when one takes note of the scope and scale of sophisticated web-based tools used by enemies of the United States. Enemies such as ISIL and Al-Qa'ida have very capably used web-based tools to raise funds, recruit members, conduct social media campaigns, and to finance and plan physical attacks. Yet the absence of cyber attacks seems incongruous with claims of an imminent cyber attack against the United States.

Defending against nuclear weapons presented significant technological challenges. In response, the United States developed and fielded land, sea, air, and space means to detect and attribute attacks employing nuclear weapons. Additionally, means to counter a small number of ballistic missiles armed with nuclear weapons are now in place despite technological challenges and high costs. While technological gaps posed major obstacles, the obligation to defend the United States against a nuclear attack demanded the creation of these capabilities. Likewise, defending against cyber threats is a challenge the United States must face to defend vital national interests.

Several notable authors[37] question the analogous value of nuclear deterrence theory and raise concerns that nuclear deterrence concepts may misinform those who devise cyber deterrence policy. While care in selecting and applying analogies to complex issues is prudent, criticisms that omit addressing the fundamental nature of deterrence obscure important lessons. Criticisms tend to focus on individual nuclear deterrence concepts that emerged within the specific context of the competition between the United States and the Soviet Union that may, in fact, misinform cyber deterrence conclusions. However, asserting "that traditional Cold War deterrence models of assured retaliation do not apply to cyberspace"[38] may inadvertently infer that assured destruction is representative of all nuclear deterrence theory concepts and then juxtapose assured destruction with cyber concepts like "mutually assured denial", even though destruction and

denial are hardly the same thing. Moreover, some of the criticisms of nuclear deterrence's analogical value fall prey to contradictions, such as conclusions to the effect "that the cyber realm is a hopelessly offensive arena where deterrence based on defensive techniques cannot be effective, while also stating that a cyber deterrence system based on offensive technologies is equally impractical and ineffective"[39]. Unfortunately, some of the most notable critics of using nuclear deterrence theory to inform cyber deterrence have helped to craft current U.S. cyber deterrence policies and strategies, which provide conspicuously little public attention to punitive and denial aspects of deterrence while placing a premium on aspirational defenses.

CONCLUSION

That nuclear deterrence theory does not inform how to deter cyber attackers is a common and dangerous misperception that generally views the former as limited to specific Cold War concepts and the latter as not susceptible to deterrence. By analogizing with the nuclear deterrence experience, it is possible to explore plausible ways ahead toward understanding how to deal with cyber threats. As a minimum, the nuclear deterrence experience indicates that a cyber "way ahead" requires amending the imbalance between defensive approaches favoring denial and the dearth of declared and overt offensive approaches that can reinforce U.S. cyber deterrence credibility. Specifically, the great apparent care taken to avoid the attribution of a cyber attack to the United States does not appear to complement cyber deterrence. As Emilio Iasiello's observation on the political context of a public U.S. "leak" about Stuxnet notes, "Not only would it have demonstrated the United States' sophisticated capabilities…it also would have shown that it could 'touch' Iran's most secret nuclear development facilities any time it wanted."[40]

As cyberspace remains a domain dominated by offensive weapons, many theorists and practitioners have concluded that "deterrence by threat of punishment remains the best available strategy for the most serious threats."[41] A prominent criticism of the 2011 U.S. cyber strategy was muting the discussion of offensive measures and cyber weapons that may provide a unique deterrent effect: "There is no penalty for attacking us now," and more measures are required to "raise the price" of a cyber attack.[42] While the 2015 U.S. Cyber Strategy does discuss building deterrence among allies and partners, the 2011 criticism continues to underscore a U.S. credibility deficiency due to a public imbalance between aspirational defenses and cyber weapons that are likely on-hand.

Learning from a mistake appears easier than learning from success or from an event that did not occur. As Keir Lieber and Daryl Press observe, "[t]he success of nuclear deterrence may turn out to be its own undoing."[43] While cyber weapons appeal to actors pursuing asymmetric strategies, cyber deterrence continues to favor status quo powers that field credible punitive and denial capabilities. The advantages minor actors may attain through cyber weapons are ephemeral because those with traditional elements of power are most able

to exploit cyber weapons in spite of also being vulnerable to cyber attacks. Nevertheless, without omniscience, one cannot rule out that an opponent will not be tempted to forego anonymity and employ cyber weapons—despite attendant uncertainties—to preserve or advance vital interests.

The alarm that a cyber Pearl Harbor is imminent does not appear to correspond with the current U.S. cyber strategy. To take the Pearl Harbor analogy further, if a catastrophic attack is genuinely imminent, then preemptive attacks against the greatest cyber threats are prudent and would, in fact, be an obligation for those charged with defending the United States. Moreover, this focus on vulnerabilities appears to have unduly narrowed early thinking on cyber deterrence. Joseph Nye observed in 2011 that, "In comparison to the nuclear revolution in military affairs, strategic studies of the cyber domain are chronologically equivalent to 1960 but conceptually more equivalent to 1950."[44] Nuclear deterrence discussions in the 1950s are similar to contemporary cyber deterrence discussions, in part, because vulnerabilities have taken center stage while considerations on how one can best re-establish cyber deterrence after an initial failure have yet to come to the fore of defense thinking. Similar the 1950s, a new weapon exists that lacks norms tempering its use, but is has been used as an instrument of force and it is held by more than one actor. Taking cognizance of nuclear deterrence lessons can improve the pace and quality of cyber deterrence discussions and allow the U.S. cyber strategy to catch up to current cyber threats and those that are over the horizon.

Genuine deterrence is not cheap. Defenses and declarations alone do not buy reliable and effective deterrence. Robust intelligence that allows one to effectively communicate threats against what opponents most value and having the means to carry out those threats buys deterrence. Nuclear deterrence lessons indicate that knowing the opponents, having credibility, and preparing for deterrence to failure are the best means for ensuring that deterrence will work by design. Revisiting these lessons can inform policy-makers on how to best sustain the absence of cyber attacks against the United States.

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BIOGRAPHY

LtCol George Núñez is a Deputy Director of CAPSTONE at the National Defense University, Washington, DC. He holds a B.A. in History and Spanish from The Citadel, a M.A. in management from National University, a M.S. in international relations from Troy University, and a M.S. in WMD Studies from Missouri State University. He previously served as a strategic planner in the Strategy and Plans Division, Headquarters, U.S. Marine Corps. LtCol Núñez is a National Defense University Countering Weapons of Mass Destruction Fellow.
george.nunez.mil@ndu.edu

BUT IS IT OK?
JUSTIFYING NUCLEAR WEAPONS EMPLOYMENT

William P. Dobbins III
Headquarters U.S. Marine Corps

INTRODUCTION

The U.S. military, as a profession, takes great pains to ensure that its members take personal responsibility for every aspect of their moral conduct. This includes, of course, the ways in which they apply force as instruments of national policy. However, underlying this expectation is the tacit assumption that the physical instruments of war themselves—the weapons with which they apply violence—are themselves morally acceptable, or at least morally neutral. Nevertheless, when it comes to nuclear weapons, military personnel are expected to assume this moral acceptability or neutrality in a social context where the shared opinion on this matter is anything but universal: Not too many people raise moral questions concerning bayonets, but they do raise them concerning nuclear weapons. Hence, the question: "What is a member of the profession of arms supposed to do with this apparent disconnect?"

In what follows, we shall explore how the tools of moral philosophy might be applied to justify nuclear weapons employment. That is not to say that moral arguments do not exist to support their non-employment. However, the task of this essay is not to take a position with respect to those arguments. It is, rather, to serve as an occasion for reflection by thoughtful military professionals who may be called upon by their political masters to use *both* bayonets and nuclear weapons. This is not a moot question: The world cannot uninvent nuclear weapons; and, given this existential fact, nuclear warfare exists as a logical possibility. Accordingly, this essay seeks to identify a moral-philosophical basis that military professional might appeal to justify employment of nuclear weapons. (In this essay, we shall distinguish between the terms "employment" and "use", with "employment" referring specifically to the operational detonation of a nuclear weapon, and "use" referring to the fact of an actor possessing a nuclear weapon. In accordance with this distinction, while the United States has not employed a nuclear weapon since 9 August 1945, it has used nuclear weapons every day since 6 August 1945 and continues to use them each day as instruments of deterrence.)

To be very clear, this essay takes no position on the alleged morality or immorality of nuclear weapons. Moreover, it does not insist that nuclear weapons should be distinguished from conventional weapons on moral grounds. Rather, it seeks only to explore possible justifications for nuclear weapons employment within the context of three of the major moral-philosophical systems of the Western intellectual tradition, namely, so-called "virtue ethics", duty-based or "deontological ethics", and "consequentialist ethics"—represented here by the

writings of Aristotle, Immanuel Kant, and Jeremy Bentham/John Stuart Mill, respectively.

THREE APPROACHES TO ETHICS IN THE WEST

In a very general way, ethical theories in the West can be categorized under one of three major headings, namely, those that understand morality as:

- One's character as manifested in one's conduct (virtue ethics),
- Universalizable rules (maxims) of conduct that one should follow (deontological ethics), and universalizable maxims that are to be followed, regardless of the outcomes they produce; and
- The most "satisfactory" outcome possible (according to some agreed standard) from available courses of action (consequentialist ethics).

VIRTUE ETHICS

In general terms, virtue ethics seeks to identify the human qualities that a morally upright person should possess. In the present context, therefore, the question becomes, "Would a morally virtuous person assent to the proposition that nuclear weapons can be justified on moral grounds?" While many formulations of virtue ethics exist, perhaps its most enduringly famous version in Western civilization was articulated by Aristotle approximately 2400 years ago.

According to Aristotle, learning virtue is not an academic endeavor. How, then, does one come to lead a virtuous life? Virtuous living, says Aristotle, is a goal attained by cultivating habits through experience—the process of "habituation"—beginning early in life and only augmented by formal education.

Deficiency	Virtue	Excess
Cowardice	Courage	Rash
Insensible	Temperance	Dissipation
Stinginess	Generosity	Wastefulness
Pettiness	Magnificence	Vulgar
Humble	High-minded	Vanity
Unambitious	[nothing]	Ambitious
Spiritlessness	Gentleness	Irascibility, Irritable
Self-Depreciation: Pretense as understatement	Truthfulness	Boastfulness; pretense as exaggeration
Boorishness	Wittiness, charming	Buffoonery
Quarrelsome, Sultry	Friendliness	Obsequious

Figure 2. The Aristotelian Virtue Ethics System[3]

According to Aristotle, virtue is defined as "a mean between two vices, that which depends on excess and that which depends on defect…while virtue both finds

and chooses that which is intermediate."[2] This "golden mean" of virtue, between the extremes of deficiency and excess, is illustrated in Figure 2. (This figure uses generally accepted translations of Aristotle's categories from the original Greek. Hence, some of the words may seem a bit odd to 21st-century readers.)

Note that virtue is not the exact, "geometric" middle between deficiency and excess, but will always vary from person to person and moment to moment. As the spectrum of possible moral traits extends between two extreme ends, virtue will fall somewhere along that middle line as each situation demands of a particular person.

This approach to ethics is one that the U.S. military Services should be quite comfortable with, as each of the Services articulate a list of essential professional "values" more or less along the lines of what Aristotle would call "virtues".

At the tactical level, in the heat of battle, when exhaustion and hunger are greatest, tragedy can occur if a moral balance between behavioral extremes is not present to guide the decisions of warriors. As one extrapolates from the tactical battlefield to the strategic battlefield, one can imagine the role that character must play in deciding to employ a nuclear weapon. Even though the decision is ultimately a political one, military professionals are not required to shed their humanity as they offer best military advice. Character-based ethical considerations would include such things as the following:

- While political decisions may require violence (since, as Clausewitz argues, war is merely an imposition by force of one's political will upon another)[4], it is incumbent on leaders to do no more harm than necessary to achieve an objective.
- It is equally important to scrupulously avoid non-combatant casualties, when possible. The tools of warfare themselves do not, as a general rule, distinguish non-combatants from combatants; so employing all such tools must be done with deep consideration on the part of those employing the tools. Even in conventional warfare, the risk to non-combatants is significant; when considering nuclear weapons, that threat could be—depending on the nature of the employment—magnified substantially.

According to Aristotle, truly virtuous can only occur if virtuous habits are realized daily. Thus, in the moment of crisis (such as when faced with the decision of whether or not to employ a nuclear weapon), it is too late, Aristotle would say, to hope to be rescued from the extremities of the situation by beginning to think about virtue if one has not become habituated to virtuous living over time.

However, Aristotle's ethics—important as they are, do not actually provide a decision procedure whereby one can deduce the answer to the question, "is it morally permissible to employ a nuclear weapon?" Rather, it requires one to approach the central question indirectly by asking instead, "would a virtuous person assent to the proposition that it is morally permissible to employ a nuclear weapon?" On this account, we can at least conclude, if the operational

employment were describable as a virtuous mean between excess and deficiency, then it may be possible to allow the employment of nuclear weapons. However, the doctrine of deterrence relies on the assumption of unacceptable damage to an opponent–hardly something describable as something other than an excess. Indeed, one would have to specify a very carefully circumscribed employment scenario to make it otherwise. Of course, one might argue that in the extreme case of the preservation of the state, an extreme display of patriotism and decisiveness would justify employment of a nuclear weapon. However, this argument betrays itself by identifying the "extreme" measures of these qualities—qualities that, when taken to such levels, are difficult to imagine being described as virtues within the context of Aristotle's system. Hence, the search for a solution that does not hinge on the presence of so highly specialized an operational context might profitably lead us elsewhere.

DEONTOLOGICAL ETHICS

Deontology is an ethical model that dictates conformity to rules. Derived from the Greek word *deon,* which means duty, and *logos,* which can be translated "study" or "science", deontology is the science of ethical rules.[5] The German philosopher Immanuel Kant is the most famous proponent for deontology. For Kant, the cardinal factor of moral decision making lies not in the character of the decision maker, per se, but in the actor's motivation. As Kant would say, "A good will is not good because of what it performs or effects, not by its aptness for the attainment of some proposed end, but simply by virtue of the volition; that is, it is good in itself."[6] Central to Kantian moral philosophy are the premises that:

- Morality is unconditional,
- It applies to all rational beings, and
- It admits no exceptions. That is to say, if act X is the moral duty for one person, then than same act would be the moral duty for anyone else in the same set of circumstances.

One might seek to justify an action as moral on the basis of a specific, present case. However, in order for a specific case to be used as an effective guide to moral action, there must first be some underlying, universalizable principle that would enable anyone to apply the specific case generally so as to include similar cases. (In this regard, and contrary to Aristotle, Kant might be expected to say that personal experience is not a necessary component for determining the morality of an action. Kant would hold that reason alone can derive the morality of an action and does so more appropriately than any specific person's experience could. After all, each person has different perceptions in the same circumstances, leading to different experiences.)

For Kant, any human duty can be translated into a command, which he calls an "imperative". There are two different types of imperatives, a "hypothetical imperative" and a "categorical imperative".

- A hypothetical imperative represents an action as good, in so far as it has *a purpose that is optional*. This imperative involves the specification of certain conditions. A general formula for this kind of imperative can be summarized by, "If A, then B." Examples include, "If you want to win at a sport, then practice until you are perfect at it" ; "If you want to be fit, then exercise regularly, eat healthily, and get plenty of sleep".
- A categorical imperative, on the other hand, is not optional; and according to Kant, the answer to any moral question, including the central question of this study, must be decided on the basis of a categorical imperative—that is to say, an action which, by its very nature is good and which must be performed in order to meet the ends of morality. In contrast to the general formula for a hypothetical imperative, the categorical imperative would state, "Do B!" Examples might be, "Tell the truth!", "Do no harm!", or injunctions of the kind found in, say, the Ten Commandments.

For purposes of moral decision making, it is the categorical imperative, and not the hypothetical imperative, that is of interest to us. According to Kant, the Categorical Imperative can be formulated in at least two ways:

- "Act according to that maxim [i.e., rule for moral conduct] which can at the same time make itself a universal law."[7]
- "So act as to treat humanity, whether in your own person or in that of another, in every case as an end and never as merely a means."[8]

For Kant, there is only one categorical imperative, and these two formulations are simply two ways of looking at the same categorical imperative.

In applying the first formulation for a categorical imperative against the central question of this study, "Act only according to that maxim whereby you can at the same time will that it should become a universal law", we find that the morality of our central question can be adjudicated by forming a maxim as follows: "I will employ nuclear weapons, in specific circumstance X, and at the same time will that all others employ nuclear weapons when faced with X." Under Kant's system, to act in a manner that does not meet this imperative, then, is to behave immorally, regardless of the consequences. That means among other things, that, whenever circumstance X is obtained, nuclear weapons should be employed, in spite of any current global or near-global norm to the contrary. The maxim would also demand an adversary to employ nuclear weapons in those same circumstances, based on the universality of the categorical imperative. Therefore, as one must act in a manner that one can will all others to act, the adversary shall also, by the same rule, employ nuclear weapons. The Categorical Imperative does not actually require that every nation possess nuclear weapons; it only requires one to imagine that they do—and, given that assumption, to imagine that one is just as likely to be on the receiving end as on the giving end

of a nuclear transaction. Thus, Kant's theory seeks to universalize a version of the Golden Rule: Instead of saying, "Do unto others as you would have others do unto you"[9], Kant is saying, in effect, "Do unto others that which you could at one and the same time will that anyone and everyone would do in that particular set of circumstances." Thus, either nuclear weapons are prohibited for all or they are permitted for all—and that, of course, causes problems which all states possessing nuclear weapons, including the United States, would wish to avoid.

Obtaining moral justification under the second formulation of the Categorical Imperative, "So act as to treat humanity, whether in your own person or in that of another, in every case as an end and never as merely a means," requires—just as Aristotle's system did, a very specialized context that involves virutally no human (or for that matter, human-impacting physical or environmental) collateral damage. Otherwise, the collateral damage would boil down to a case as using human beings as collateral means to justify a political end; and Kant's system will not permit the use of human beings as anything other than ends. An argument might be made that would allow for the employment of a nuclear weapon merely as a demonstration—as a deterrent threat. However, for a threat to be worthwhile, it must be credible. Credibility of a threat comes from the idea that such an action might be inflicted upon an adversary. In light of the Categorical Imperative, however, the credibility of such a threat is challenged by the very idea of what a nuclear demonstration seeks to achieve, namely, the assumption that if, in light of the demonstration, an adversary will not submit to the desires of the demonstrator, substantial injury to *humans* will ensue!

In his famous *Grounding for the Metaphysics of Morals*, Immanuel Kant argues that there is only one thing that is inherently good, without the need of justification or qualification, and that is a "good will"[10]. A good will is the motivation for simply doing what is right because it is right, not because there may be a success in doing it or failure in doing it.[11] What is critical in this postulation is that it is the *intent* that is important—not the consequence. A good will may not be the only good, or even the complete good of an action; however, it must be ruled as the morally definitive good among all others. Even other characteristics that may be considered good are not inherently so. "Intelligence, wit, judgment, and other talents of the mind, however they may be named...these gifts of nature may also become extremely bad and mischievous if the will which is to make use of them, and which therefore, constitutes what is called character, is not good." [12] Thus, according to Kant, the morality of an action is based on good will as derived from reason. As one applies the previous formulations of the Categorical Imperative to our central question of this study, the answer to both formulations must stem from a good will, as opposed to, say, desired outcomes. Distilling this scenario to the most fundamental level would have Kant ask, "could a person of good will:

- Assent to the proposition that employing nuclear weapons is an act that could be made a universal law *at one and the same time*?
- Assent to the proposition that employing a nuclear weapon is an act that would never involve using either oneself or anyone else as merely a means to an end?"

To answer this question in the affirmative would lead to the conclusion that deontology *could* be used to justify the employment of nuclear weapons. As a practical matter, however, to do so is a very tall order.

Even in the extreme case of nuclear employment by a state on the cusp of defeat, the employment would be more likely than not for vengeance; and vengeance is not the product of a good will. Moreover, vengeance in that case would be an *end*, achieved by using mass death and destruction of people as the *means*; and using humans as means is, for Kant, morally unacceptable. Finally, to use the Categorical Imperative to justify the employment of a nuclear weapon is self-defeating. To will that the employment of nuclear weapons be a universal law, when taken to its (il)logical conclusion, is to accept that civilization will be placed at great risk of nuclear holocaust. None of this indicates that nuclear weapons are any less moral than conventional weapons; it merely means that deontological moral theory, like virtue ethics theory, is probably not a vehicle that is likely to yield moral permission to employ nuclear weapons. While there are other variations of deontological ethics, both the methods to determine the ethics of an action and the requirement to will that an action be universalizable in order to be ethically permitted are indicative of those found throughout deontology.

CONSEQUENTIALISM

Consequentialist ethical models hold that the rightness or wrongness of a moral choice depends upon the outcome that the choice produces. In stark contrast to Kant, the intention of the action is not important; only the result is. An oversimplification (but perhaps only slightly) would be the famous adage, "The ends justify the means." Thus, all forms of consequentialism must have the following characteristic: "Any consequentialist theory must accept the claim… that certain normative properties depend only on consequences."[13] In order for consequentialism to sanction nuclear weapons employment, the end result of employing nuclear weapons must produce a better outcome—consequence—than not employing nuclear weapons.

While there are many different sub-categories that may fall under the umbrella of consequentialism, this section will focus upon two of its most famous sub-categories: ethical egoism and utilitarianism[14]. Ethical egoism is an ethical system that produces the most favorable outcome for the individual. Utilitarianism is an ethical system that produces the most favorable outcome for the greatest number of people, each person counting as one, and as no more than one.

ETHICAL EGOISM

Because ethical egoism holds that an action is moral if it maximizes the benefit for the self, ethical egoism leads to the conclusion that actions that benefit the self are "good" even if at the expense of the general welfare. In its strongest theoretical formulation, ethical egoism holds that it is always moral to promote one's own good, and it is never moral not to promote it. More weakly formulated, it may be said to hold that, although it is always moral to promote one's own

good, it is not necessarily never moral to not. That is, there may be conditions in which the avoidance of personal interest may be a moral action.[15]

Ethical egoism implies that each agent is behaving morally if each agent pursues his or her specific interests. This theory is fine, of course, until there are multiple moral agents with competing needs. Once that situation occurs—as is, in reality, always the case, the question arises as to which agent should achieve its ends, even if doing so occurs at the expense of the other? However, to be a consistent ethical theory, the theory must apply to others as well as to the self.

This conflict between multiple agents pursuing self-interest rises to a new level and becomes particularly problematic when applied to a social interaction as complicated as warfare. In a scenario where two agents, whether individuals or states, have diametrically opposed self-interests, there will be a need to end the resulting tension. When either agent determines that his or her interests may best be met with the defeat of the other, conflict is sure to ensue. To bring such scenario into the world of nuclear weapons, the need to ensure the primacy of "self" (in terms of the collective "self" implied by the concept of statehood), would justify the employment of nuclear weapons. This might satisfy the moral egoist but only at a very high price; for, to remain consistent with the theory of ethical egoism, one must also account for others also acting under the same set of rules. Hence, the counter argument against ethical egoism as a moral justification for nuclear weapons employment arises from the contradiction found within the system itself: To argue that one side has a moral right to employ nuclear weapons, in pursuit of objectives is to accept that the other side also has that moral right; and that is a "right" which, for many good reasons, a state (including the United States) may not be willing to grant.

Embracing moral egoism leads conveniently to the realist notion that "might makes right" and essentially demands that nuclear weapons be treated merely as another kind of conventional arms. Regardless of their indiscriminate nature, regardless of their massive destructive power, regardless of their residual environmental effects, the employment of such weapons is allowed by the moral egoist because defeating an enemy is within the bounds of self-interest; the manner in which that occurs seems to be irrelevant. Regardless of the global implications, as long as the "self" is saved, and victory achieved, nuclear weapons are treated simply as another tool in the armory. In a world dedicated to ethical egoism, a stronger entity will simply rule over the weaker. However, when both sides possess nuclear weapons, it is not entirely clear what concepts like "stronger" or "weaker" might actually mean. Thus, in light of the high-stakes calculus of nuclear confrontation, moral egoism becomes nothing more than another name for realism[16].

At its logical conclusion, one side should see that employing nuclear weapons, for personal/national gain, would lead to a military exchange where both sides are free to employ such weapons. Given the extreme damage that nuclear weapons produce, this is not self-interest at all; even in defeating the adversary, such strategic exchanges may lead to a catastrophic ending for both sides. Even

in winning, both sides lose; this is most assuredly not self-interest. Thus, both as a practical guide for action and as an ethical theory, ethical egoism offers little to illuminate moral questions surrounding nuclear weapons employment.

UTILITARIANISM

Utilitarianism, another sub-category of consequentialism (but one which, nonetheless stands in stark contrast to ethical egoism), may well constitute the very best candidate as an ethical system to justify the employment of a nuclear weapon. Utilitarianism is a normative ethical system based on the principle that, "actions are right in proportion as they tend to promote happiness, wrong as they tend to produce the reverse of happiness."[17] Furthermore, happiness is generally defined as pleasure or the absence of pain. To sum up this ethical theory, it might be said that the greatest good—and, from the standpoint of the utilitarian, the *only* true moral good—comes from promoting the greatest happiness of the greatest number of people affected by a decision.

Jeremy Bentham, an early proponent of modern utilitarianism, argued for social and political reforms in England as well as in the newly formed United States. In his treatise entitled "An Introduction to Morals and Legislation", Jeremy Bentham articulates the principle of utility, which, according to Bentham is the "principle that approves or disapproves of every action according to the tendency it appears to have to increase or lessen—i.e. to promote or oppose—the happiness of the person or group whose interest is in question."[18] Bentham defines happiness as pleasure or at least the absence of pain. Moreover, Bentham argues that happiness can be quantified by such characteristics as its intensity, duration, certainty, and nearness. Throughout his treatise, Jeremy Bentham shows example after example of consequences working at cross purposes with intent and motivation. It is because of this potential misalignment of intent and consequence that Jeremy Bentham focuses on consequences as more important than motive. (Interestingly, Jeremy Bentham spent a great deal of time discussing important aspects that might be related to just war theory, including the morality of the threat of punishment (deterrence) and the idea that the punishment should fit the offense (proportionality))[19].

Bentham's utilitarianism theory received further refinement under John Stuart Mill, who bases utilitarianism on the principle that "actions are right in proportion as they tend to promote happiness, wrong as they tend to produce the reverse of happiness", with happiness defined as pleasure or the absence of pain. Mill categorizes happiness as realizable in terms of either "base" pleasures or "higher". Further, in the prioritization of happiness, the higher pleasures should be weighted more than the baser ones. Mill argues that weighing virtuous living and other higher goals more heavily than baser pleasures will provide a more wholesome form of happiness. For Mill, pleasure may be a component of happiness, but happiness in its noblest form comes from the higher inclinations of the mind, not the body. Like Aristotle before him, Mill argues that happiness is the sole basis of morality and that humans really do not seek for anything other than happiness.[20] As Mill asserts, "The utilitarian doctrine is, that happiness

is desirable, and the only thing desirable, as an end; all other things being only desirable as means to that end."[21] Mill explains at length that desires like justice are actually based on utility, and that rights exist only because they are necessary for human happiness. Hence, all morally worthy desires lead to happiness, regardless of the path taken to arrive at that destination. If Mill is correct with respect to happiness (and a strong argument can be made in behalf of the proposition), then nuclear weapon employment is morally permissible if doing so maximizes the happiness (i.e., minimizes the pain and, as a result, maximizes the pleasure) of the majority of persons affected by the decision.

Utilitarianism can also be considered a common-sense approach. If an action is certain to have a poor outcome (as understood in terms of happiness), even if that action is *intended* to achieve good, then it would make sense to avoid taking that action, regardless of the intent. For example, if someone in 1930s Germany were confronted by Nazi Gestapo officers and asked if he or she were hiding any Jewish persons, under a virtue ethics or a deontological system, one would be hard pressed to reach the conclusion that lying, to save the life of a threatened person whom he or she had concealed, was morally permissible—even though telling the truth could be expected to lead to the death or injury of the concealed person: an immoral ending to be sure, even if ethically consistent. In stark contrast, under utilitarianism, saving the sought-after person by lying would lead to a better outcome for the majority of those involved in the transaction. This is an obvious example of why Mill believes that the end is more important than the means. The greatest happiness principle claims that pain-producing actions (i.e., actions that produce the opposite of happiness) are immoral. Moreover, Mill argues that, because of the rational capacity that human beings possess, it is possible to reason that, short-term pain may be considered moral in order to achieve a comparatively pain-free end in the long-term. An example of this might be that, in order to live a longer and healthier life, one should manage one's diet properly and exercise regularly. Not eating and drinking the food that one desires may lead to the short-term pain of self-denial. Likewise, regular exercise is difficult and causes discomfort, even if the long-term benefits are clear. However, in the end, one may be expected to live a longer, healthier life due to imposing the pain of self-restraint in eating and the discipline of regular exercise. This ability to think in future terms means that humans are able to consider their actions, think through the consequences of those actions, and then decide on a course that will produce the greatest happiness for all the people relevantly involved over the long term. In this respect, utilitarianism might lead one to the conclusion that nuclear weapon employment would result in a more satisfactory long-term outcome even if, in the short term, happiness would not be maximized.

Utilitarianism has other characteristics that help one calculate the morality of an action. Mill's utilitarianism requires that all persons be treated as equals, such that each person has an equal "vote". That is to say; the interests of one person do not outweigh the interests of any other individual. Utilitarianism is actually quite straightforward in its application. There are not vague concepts about motivations or the intention, or the determination of where the mean between extremes is; either an action produces happiness, or it produces pain. Happiness

production is not abstract. There may be distinctions between long-term happiness and short-term happiness, but end result sought by utilitarianism is to maximize happiness and minimize pain.

It can seem counter-intuitive to invoke concepts like happiness and nuclear weapons employment in the same sentence. However, in the most fundamental sense, happiness, at least as it is understood to involve an absence of pain, surely is a consideration that must factor in the calculus of nuclear weapons employment. Indeed, when using utilitarian analysis in the world of war, and further, into nuclear war, the use of the greatest happiness principle may well be the *only* justification that can support nuclear weapon employment. Indeed, it would appear that if the employment of a nuclear weapon could be expected to lead to the happiness or reduction in pain for a great many more people than would encounter pain as the result of nuclear weapon employment, then the requirements of the "greatest happiness principle" would have been met, thus justifying the employment. What is more striking, under the rubric of the greatest happiness principle, nuclear weapon employment might not only be morally justifiable, it might actually be morally obligatory!

UTILITARIAN CASE STUDY: THE BOMBING OF HIROSHIMA AND NAGASAKI

The bombs dropped on Hiroshima, and Nagasaki are the only nuclear weapons that, to date, have been employed operationally. Hence, this case study provides the only historical example to which we can appeal for the moral justification for this type of military engagement. In a utilitarian justification, it is important to remember that the use of a nuclear weapon must lead to greater happiness than would otherwise be the case. There must be some consequence that is more terrible by *not* employing the weapon than by employing it.

At the end of World War Two, the American objective in the Pacific was the unconditional surrender of the Japanese. Unconditional surrender of the Japanese was a daunting task for which there were few options for achievement. Revisionist history occasionally leads to the position that both the planned invasion and employing atomic weapons were unnecessary: Over the course of the final months of the war, the Japanese were being defeated at every turn, and the island-hopping campaign was a brutal success. These successes, however, do not necessarily mean that Japanese surrender was forthcoming. The following alternatives to nuclear weapon employment were reasonably available to President Truman for concluding the war:

- Intensify conventional bombing and naval blockade of the islands and starve the whole Japanese nation into submission
- Allow the Japanese to retain the emperor on the throne in the traditionally recognized sense.
- Wait for the USSR to declare war against Japan and see where that might lead.[22]
- Invade the Japanese mainland.

However, to suggest that these alternatives actually might have been expected to produce the greatest happiness for the greatest number, each person involved counting as one and no more than one, is quite a different matter. Consider the following:

- Maintaining the naval blockade in place around the islands of Japan may have led to Japanese capitulation. Some argue that this course would have defeated the Japanese in a short period of time. Others argued that it might take substantially longer, given the commitment of the Japanese to continue the war, and would lead to considerably more Japanese casualties from starvation and disease. In 1983, at the annual observance of Hiroshima's destruction, an aging Japanese professor recalled that at war's end, due to the extreme food rationing, he had weighed less than 90 pounds and could scarcely climb a flight of stairs. "I couldn't have survived another month," he said".[23] This professor was not alone; he was only one of an entire nation that would have been similarly affected.
- Allowing the Japanese to retain the emperor would have changed the "unconditional surrender" put forth by the Allies with respect to the war in the Pacific. Given the zeal of Japanese people toward the emperor, it was thought that unconditional surrender would mean the deposing of the emperor, an outcome that was not supportable by the Japanese people. Surrender may have been more palatable with guaranteed retention of the emperor and may have led to the capitulation without the employment of the atomic bomb. However, a strong argument can be made that this course was not politically supportable within the United States. Americans had sacrificed far too much from Pearl Harbor to the Bataan death march. Moreover, the retention of the emperor could only be something granted by the United States, not negotiated by the Japanese.
- With respect to awaiting the entry of the USSR into the war, a high suspicion of, and little confidence in, Soviet post-war intentions made this course of action practically untenable. On this account, the ensuing decades of the Cold War experience verify that suspicion was thoroughly justified.
- When considering an invasion of the Japanese home islands, President Truman's calculus was informed by recent experience in the island-hopping campaign of the Pacific theater, and various casualty estimates provided by military experts and leaders. According to General George C. Marshall: "We had to assume that a force of 2.5 million Japanese would fight to the death as they did on all those islands we [already attacked]…We felt this despite what [Army Air Force] generals with cigars in their mouths [an obvious reference to Curtis LeMay] had to say about bombing the Japanese into submission. We killed 10,000 Japanese in one raid, in one night, but it didn't mean a thing insofar as actually beating the Japanese".[24] From the staff of General Marshall to the staff of Admiral Nimitz, casualty estimates ran from 31,000 to 50,000 in the first 30 days. Total casualty estimates included

- An estimate of 1,200,000 casualties, with 267,000 fatalities…. Chief of Staff to the Commander in Chief, estimated 268,000 casualties (35%). Former President Herbert Hoover sent a memorandum to President Truman and Secretary of War Stimson, with "conservative" estimates of 500,000 to 1,000,000 fatalities. A study done for Secretary of War Henry Stimson's staff by William Shockley estimated the costs at 1.7 to 4 million American casualties, including 400,000–800,000 fatalities.[25]

These same war planners also believed that the Japanese would suffer an even greater number of casualties.

A concurrent, though ironic argument supporting the use of the bomb is that, because of the expected Japanese resistance to an invasion of the home island, its use actually saved Japanese lives. The study done for Secretary of War Stimson predicted five to ten million Japanese fatalities. Since the end of the war, even some Japanese have taken account of this grim prospect. As one Japanese war survivor stated, "If the military had its way, we would have fought until all 80 million Japanese were dead. Only the atomic bomb saved me. Not me alone, but many Japanese, ironically speaking, were saved by the atomic bomb."[26]

It would be much easier to justify the employment of a nuclear weapon if a leader had only to define the "common good" as the people of his or her nation. However, the utilitarian calculus requires that the happiness of *every person* relevant to the issue be considered. It is important to note that President Truman defined the "common good" and the population of concern for the greatest happiness principle to include the Japanese. Said he, "My object is to save as many American lives as possible but I also have a humane feeling for the women and children in Japan".[27] Thus, on the basis of utilitarian calculus, Truman authorized the employment of the atomic bomb.

POSSIBLE COUNTERS TO UTILITARIANISMILITARIAN ARGUMENTS

Any reasonable, balanced argument of the relative merits of utilitarianism as the best possible moral justification for nuclear weapon employment requires an equally reasonable, balanced consideration of possible counterarguments. Some of the principal arguments that might be expected to be brought to bear against nuclear weapons employment on utilitarian grounds:

- Proportionality. By virtue of their characteristics, the effects of nuclear weapons go beyond the intended target. With fallout and radiation effects, even the battlefield may not be sufficiently large to contain the effects of a nuclear weapon. With the potential spread of fallout and radiation, many more people may be painfully impacted than receive any happiness from the employment of a nuclear weapon. The balance of happiness must fall to the advantage of those left over, vice those killed in the attack. If the results are not reasonably predictable or exceed the intended number of casualties, then the greatest happiness principle may not fall to the side that employed the nuclear weapon. The larger point here is the difficulty

that arises from trying to define the relevant population. Even in the best, most circumscribed case, the nature of nuclear warfare makes the "greatest happiness" an extraordinarily difficult thing to calculate.

- Discrimination: Many of today's nuclear weapons are multiples larger than those employed in World War Two and would cause damage and death well beyond the intended target. Even if we are to accept non-combatant casualties as a necessary evil to achieve an objective, the extraordinary damage caused by nuclear weapons would likely go beyond anything close to the "good" outcome that is sought, potentially invalidating the "greatest happiness principle."

Nevertheless, just because problems with proportionality and discrimination surely exist, that does not mean that they are necessarily insurmountable. As a result, it may be argued that a utilitarian approach is the one most likely to yield a successful moral-philosophical account justifying nuclear weapons employment.

CONCLUSION

While each ethical system considered above provides certain guidelines for behavior and actions, they do not all provide a mechanism by which the employment of a nuclear weapon can be justified. Aristotelian ethics (virtue) provides a sliding scale based on *how* an agent should strive to find virtue between excess and deficiency. However, Aristotle's system indicates no way to achieve permission for nuclear weapons employment through identification of a virtuous "mean". Similarly, deontological ethics, requiring as they do the treatment of human beings only as ends and never as means, cast a general pall over attempts to justify warfare of all kinds as an instrument of national power, and not only nuclear warfare. In contrast, an ethic that adjudicates moral questions on the basis of outcomes, as does utilitarianism, offers some promise for untangling the difficult moral-philosophical problems of nuclear warfare.

This essay does not insist that nuclear weapons, by their nature, are either moral or immoral. It simply argues that the moral-philosophical vehicle most likely to justify nuclear weapons employment is a utilitarian one. Whatever the case, one thing is certain: The political and military leaders of a state with nuclear weapons have the same fundamental moral responsibilities with respect to decisions to undertake state-orchestrated violence as do those without nuclear weapons.

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BIOGRAPHY

Major William P. Dobbins III is the USMC Engineer Occupational Field Sponsor at Headquarters Marine Corps (HQMC), under the Deputy Commandant, Installations and Logistics, at the Pentagon. He holds a B.S. in political science from the United States Naval Academy and a M.S. in Weapons of Mass Destruction Studies from Missouri State University. He was previously assigned as the USMC Engineer Capabilities Officer under the same Deputy Commandant at HQMC. Maj Dobbins is a National Defense University Countering Weapons of Mass Destruction Fellow.
william.dobbins@usmc.mil

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Ms. Hannah Kraushaar, CWMD Education Program Manager
Email: CWMDFellowship@ndu.edu
Phone: 202-685-3127


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