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Challenging Nuclear Abolition

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Foreword

The attractiveness of Adam Lowther's study of American nuclear weapons policy is that it explains the complexities of the issue in very clear terms. It will help all readers understand the debate. In particular, it frames the issue of nuclear weapons in relationship to the most basic concept of primary importance—how we view American strength in the world.

Nuclear weapons policy has recently gained national exposure by the fact that the president declared a desire to reduce the number of nuclear weapons with a final goal of eliminating them all together. The other factor that gave yeast to the issue was the pronouncement by former secretaries of state Henry Kissinger and George Shultz; former secretary of defense William Perry; former senator Sam Nunn; and other luminaries that the nation should support elimination of nuclear weapon all together.

Dr. Lowther breaks down the elements of the debate between "abolitionists" on the one hand, and the "modernizers" on the other, who have opposing views of the utility of nuclear weapons. What makes the issue complex is that there is clearly a value to nuclear weapons, and total elimination tends to be a far off, if attractive goal. In the meantime the nation has to decide how to deal with our reality which not only has national and international deterrent implications, but is also a matter of science. In the interim the nation must modernize its weapons because they are getting old. We must also update our delivery systems and even decide whether we need three systems: airplanes, missiles and submarines. Finally, we need to refresh our aging scientist and engineering base. We cannot easily replace those who put together our current arsenal.

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About the Author

Dr. Adam Lowther is a military defense analyst at the Air Force Research Institute, Maxwell AFB, Alabama. He is the author of *Americans and Asymmetric Conflict: Lebanon, Somalia, and Afghanistan* and coeditor of *Terrorism's Unanswered Questions*. Dr. Lowther has also written papers on the Iraq War and military strategy. He would like to thank the members of the Air Staff, US Strategic Command, Global Strike Command, and the Institute for Deterrence Studies who provided extensive feedback on drafts of this article.

Summary

A generation after the fall of the Berlin Wall and the collapse of the Soviet Union, the United States stands at a crossroad. One path leads to a reinvigoration of the nuclear enterprise, while the other promises an end to nuclear weapons.

Those that advocate the recapitalization of the nuclear enterprise fall into the "modernizer" camp. They believe that America's nuclear arsenal prevented the United States and Soviet Union from engaging in a large-scale conventional conflict during the Cold War. Deterrence was successful because the consequences of its failure were too terrible to risk. Thus, the modernizers advocate a renewed emphasis on the nuclear enterprise, design of new warheads, and the development of new delivery platforms. For modernizers, capability and credibility are inextricably linked, and both are an important element of deterrence. And, perhaps most importantly, modernizers do not believe that the end of the Cold War fundamentally changed the nature of power, persuasion, and the use of violence. Today, just as during the Cold War, nuclear weapons remain a vital element of US national security.

Those advocating that the nation follow a different path are the "abolitionists." Often found in academia, Washington-based lobbying organizations, and the remnants of the peace movement, abolitionists are focused on eliminating nuclear weapons completely. They suggest that these weapons are too destructive and could fall into the hands of someone willing to use them. Thus, the United States must lead the way in their reduction and elimination. As abolitionists suggest, the world will be a safer place without them.

This msonograph challenges the logic of nuclear abolitionists, addressing each of their arguments and highlighting the flaws. It also suggests that nuclear weapons are as relevant today as they were during the Cold War. They continue to force America's adversaries to move down the spectrum of violence, choosing means that do not present an existential threat to the nation.

Challenging Nuclear Abolition

On 5 April 2009, the president of the United States stood before a cheering crowd in Hradcany Square in the Czech Republic's capital of Prague. He spoke at length about his desire to continue reforming America's nuclear enterprise, including pursuing additional nonproliferation agreements with the world's nuclear powers.[1]

There can be little doubt that 2009 and 2010 are certain to be historic years for the United States. With the country facing economic and security challenges, tough choices regarding defense spending and national security strategy are likely to come, and they may significantly affect nuclear weapons policy. Although the president's efforts to develop a "new New Deal" may overshadow shifts in nuclear weapons policy, Pres. Barack Obama may oversee a truly unprecedented change in the number of deployed strategic nuclear weapons and the policy governing their use.

In 2009–10 the administration will produce a Nuclear Posture Review (NPR), which will serve as the rationale for major revision to the current policy, and oversee the expiration and/or possible extension of the Strategic Arms Reduction Treaty (START), which expires on 5 December 2009. The president will also be responsible for ensuring compliance with obligations in the Strategic Offensive Reduction Treaty (SORT), which requires the United States to reduce its operationally deployed strategic warheads from around 5,000 to 1,700–2,200 by 2012. In addition to the president's Prague speech, the White House released President Obama's agenda, stating the policies he will pursue regarding the nuclear arsenal. According to the White House, there are three foci of the president's nuclear agenda: securing loose nuclear material, strengthening the Nuclear Nonproliferation Treaty (NPT), and moving toward a nuclear-free world.[2]

Attempting to influence President Obama's nuclear weapons policy are a number of disparate groups with very different views on the appropriate size of the nuclear arsenal, the role of nuclear weapons, and the best approach to achieving deterrence. Although it is difficult to accurately present the separate and distinct views of individuals once they are aggregated into

a group, it is useful to represent the diversity of thought on nuclear weapons by dividing those who write about, think about, and make nuclear weapons policy into two, somewhat mutually exclusive, groups.

On the one hand are "modernizers," with many in this group drawn from the leadership of the Departments of Defense (DOD) and Energy (DOE). Between 2006 and early 2009, these military leaders oversaw the production of a substantial number of reports and studies addressing questions related to nuclear weapons policy and the broader nuclear weapons complex. They gave a number of public speeches and interviews while also writing various articles that outlined their thinking on the issue.[3] What is clear is that modernizers see the nuclear arsenal as playing a vital role in preserving the national security of the United States and its allies. The modernizers believe that the United States must develop a new warhead and advanced delivery platforms if the nation wishes to maintain the most advanced and secure nuclear arsenal in the world.[4] Recent reports published by such groups as the Task Force on DOD Nuclear Weapons Management, Defense Science Board, and the Air Force helped shape the current views of modernizers.[5]

On the other hand are the abolitionists. Although they do not have a clearly defined leadership, it is clear that some will assume key roles in the current administration. Former secretaries of state Henry Kissinger and George Shultz; former secretary of defense William Perry; former senator Sam Nunn; Ivo Daalder, Senior Fellow at the Brookings Institution; Jan Lodal, past president of the Atlantic Council of the United States; billionaire Richard Branson; and a substantial number of senior faculty at elite universities support nuclear disarmament in recent writings and efforts. While it would be incorrect to suggest that these two groups necessarily have an adversarial relationship, they do represent very different visions for the nuclear arsenal.

Because of the president's past support for reducing and eliminating nuclear weapons, opponents of the nuclear arsenal see an opportunity to oversee substantial reductions in the number of nuclear warheads and their delivery systems.[6] Prior to President Obama's electoral victory in November, numbers of reports were published calling for the reduction or elimination

of the nuclear arsenal. And, since President Obama's inauguration, members of the abolitionist movement have assumed prominent positions in the administration, with the recent confirmation of Rose Gottemoeller as the assistant secretary of state for verification and compliance being one example.

Based on information flowing from the White House, the Pentagon, and news outlets, it is reasonable to suggest that abolitionists are now in ascendance, with modernizers clearly concerned that proposed reductions will go too far and jeopardize the continued credibility of US nuclear deterrence. This concern is also shared by many within the DOD and the DOE at lower levels.

The pages that follow take a critical look at the fundamental arguments offered by abolitionists and conclude that the rationale offered, while admirable, is utopian and makes predictions about human behavior that are not supported by historical example or logic, which must be relied on when examining nuclear deterrence. Successful deterrence, conventional or nuclear, is difficult to demonstrate since "proving the negative" is exceptionally hard. This requires the reader to balance the need for empirical evidence with the need to act as Thomas Schelling's "armchair" strategist.

Nuclear Modernization

The rationale for modernization of the nuclear arsenal is extensively described in a number of DOD reports issued between 2006 and 2009. Pentagon leadership has highlighted three pressing needs to modernize the nuclear arsenal. First, the United States has not developed a new nuclear warhead in more than two decades.

Although the current stockpile is regularly maintained, most of the warheads were designed and built either in the early 1960s, the late 1970s, or early 1980s. It is important to note that nuclear warheads were designed to be replaced every 10–15 years, which was the case for more than 40 years. This led top policy makers and military leaders to call for the development of a safer and more technologically advanced Reliable Replacement Warhead (RRW).[7] See appendix for a complete list of all manufactured US nuclear warheads.

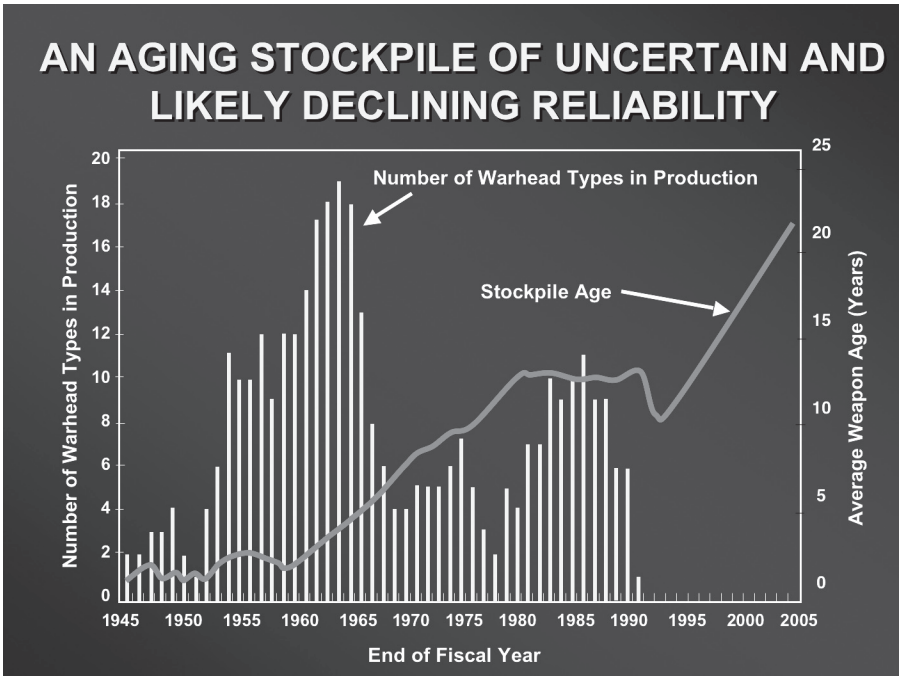

Figure 1. An aging stockpile of uncertain and likely declining reliability.
(Reprinted from a briefing by retired admiral Richard Meis.)

Shortly after taking command of US Strategic Command (USSTRATCOM), which is the combatant command responsible for US nuclear war plans, Gen Kevin Chilton spoke to attendees at the "Strategic Weapons in the 21st Century" conference in Washington, DC. An excerpt from his speech provides excellent insight on this specific issue:

> The primary design requirement in the 50s and the 60s was to maximize yield and minimize volume. We had certain size rockets that could carry certain size things, and we wanted to get as many warheads as we could available to the nation. That's what we needed to do in the Cold War.
>
> The longevity of the weapons, performance margins, and manufacturability and maintainability were requirements that were traded off and prioritized lower than bang and volume. And I think that's an important point. That is what we are living with today are those weapons, and those were the requirements that laid the foundation for what we have today.

He continued, making a significant point, which plays a key role in shaping the outlook of modernizers.

> Tight performance margins and maintainability. Why were we able to trade those off? I think there are a couple of reasons. One, we had an engine in place to produce weapons at a pretty phenomenal rate, and the thought was we could replace them and we did in fact, with new designs about every 15 to 20 years, if not more frequently. And we kept them. So you could take risk in your design, maximize bang, minimize volume, take risk in maintainability, take risk in margins because of those two factors.
>
> Then what happened in the 1990s? We took away some underlying assumptions that bolstered those requirements on which you'd like your weapons to look like. We got rid of our production capacity in this country and we stopped testing. So now things like maintainability and performance margins come to the forefront in the discussions on what you really want in the weapons that you have assigned to you to conduct your mission as the Strategic Command Commander.

One additional point is worth noting because it underscores much of the support for such programs as the RRW. As General Chilton stated,

> The other thing I learned about nuclear weapons is when you set one off it's a high energy physics experiment. It's pretty hard to understand and explain in models, but we're trying like crazy to do all that. But when they're sitting on the shelf what I didn't appreciate was that they're chemistry experiments. They're chemistry in motion. Things are changing. They're not static at all. In fact the physics package is not static and the things that surround the physics package are being impacted by the fact that it is not static. It affects the life and functionality of any nonnuclear and in some cases nuclear components of the weapon system that are absolutely important to the function of the system.[8]

The second point regularly highlighted by modernizers focuses on the aging personnel responsible for designing and maintaining the nuclear stockpile and the important point that most of these scientists are rapidly approaching retirement. There is an immediate need to find young scientists and engineers willing to dedicate their careers to the nuclear mission before the knowledge and skills of the present workforce are lost.[9]

General Chilton said of the scientists who design and maintain the nation's nuclear weapons, "Someone said, I'll steal this quote from somebody, 'The knowledge of how to design and fix and work on and understand nuclear weapons in the country

today is aging faster than the plutonium in the weapon system.' That is a real concern. A real concern. Human capital is every bit as important to having a nuclear capability second to none as is the appropriate bricks and mortar and infrastructure to support that capability."[10]

Third, the weapons platforms responsible for delivering the nation's nuclear weapons to their targets are also aging. This is of particular concern for the Air Force, which is responsible for two of the three legs in the nuclear triad: intercontinental ballistic missiles (ICBM) and bombers. Although some of the subordinate systems in ICBMs and nuclear bombers are periodically upgraded and modernized through various programs, such as the life extension programs, the remaining 450 Minuteman III ICBMs were designed in the early 1960s and are older than the Airmen managing and maintaining them.[11] This problem will only worsen because the Minuteman III is mandated to remain in service until 2030. The B-52H, the mainstay of nuclear-capable bombers, is even older and is unable to penetrate defended airspace.[12] And, like the Minuteman III, the 76 remaining B-52Hs are expected to continue in service until 2030–40. The 19 current B-2 bombers, designed while Pres. Ronald Reagan was in office, remain the fleet's only nuclear-capable bombers that can potentially penetrate defended airspace.

The Air Force was developing the next generation bomber (NGB) as a stopgap measure until the maturation of hypersonic technology.[13] But, with the recent release of Secretary of Defense Robert Gates's budget, the NGB will not continue in development, perhaps because some in the Obama administration questioned whether a bomber with the NGB's limited capabilities is a wise use of precious resources.[14] In a fiscal environment where the federal government is borrowing at record levels, and in an administration that has expressed a desire to reduce defense spending, it may be unlikely that the president will support a new multibillion dollar bomber program anytime in the near future. Given the negative coverage in the press and Congress the Air Force has received regarding the F-22, the leadership may also be unwilling to risk such criticism for a bomber that is considered an interim solution.[15]

On a more positive note, America's fleet of 14 ballistic missile submarines (SSBN) is in the best relative condition of the nuclear

Figure 2. B-52H bomber. (USAF photo by MSgt Mike Kaplan)

weapons delivery platforms but is also aging. The nation's oldest Ohio class SSBN, the USS *Henry M. Jackson* (SSBN 730), was commissioned in 1977 while the newest, the USS *Louisiana* (SSBN 743), was commissioned in 1997. A replacement for the Ohio class SSBN is not scheduled to enter service until 2029.[16] Absent a change in current planning, the United States will be replacing every major nuclear weapons platform (Minuteman III, B-52H, and Ohio Class SSBN) at approximately the same time. If past and current examples of weapons development and procurement are any indicator of future performance (e.g., B-1B, B-2, F-22, Future Combat Systems), delays and cost overruns may make it unfeasible to replace these vital delivery systems at the same time.

As General Chilton said in recent testimony before the House Armed Services Committee, "USSTRATCOM's job is to ensure that our national leadership has credible capabilities available,

and that adversaries and allies alike grasp their nature and our constant readiness to employ them."[17]

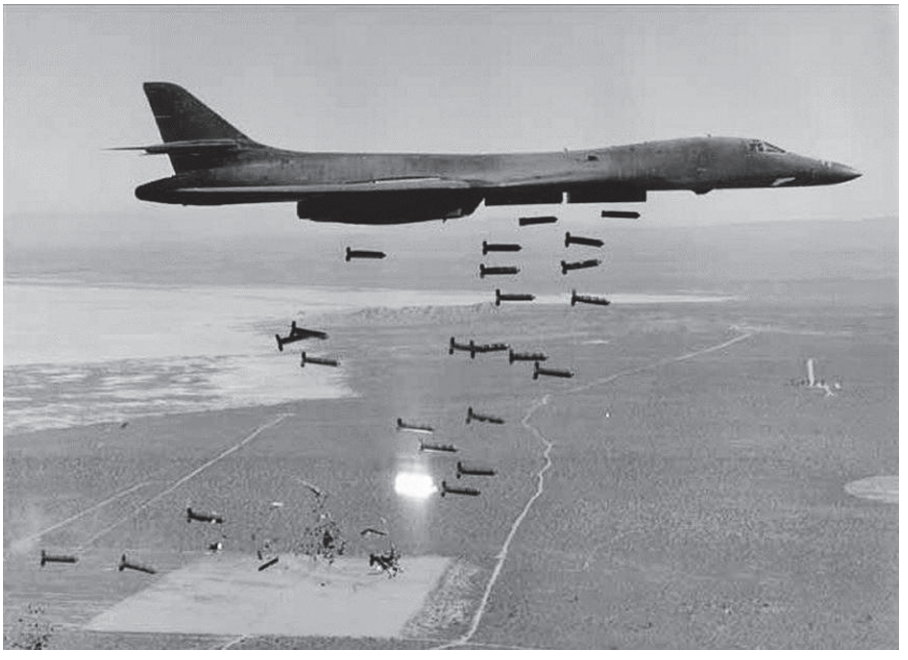

Figure 3. B-1 bomber. (USAF photo)

The professional bureaucracy in the DOD and DOE is a repository of knowledge on the subject and generally stable across administrations. Among the Obama administration political appointees, there is a clear shift away from a preference for modernization, which was promoted during the Bush administration. All members of the bureaucracy, however, are careful not to be viewed as overtly political, which makes it difficult to gage the exact level of support for modernization.

This effort to remain nonpartisan often leads analysis in official documents to focus on operational system strengths or weaknesses and technical requirements. Broader political/strategic issues are more frequently avoided as senior officials seek to avoid wading into shark-infested waters, and with good reason. Most official publications also avoid overtly challenging

an administration or its political detractors. The weakness of this approach to addressing key issues is that it cedes the high ground, in this case, to nuclear abolitionists. Thus, these pages focus on providing a clear understanding of the arguments advanced by modernizers and their critique of nuclear abolition in an effort to provide a better understanding of the less frequently heard side of this debate. In doing so, there is a desire to promote a healthy debate about the usefulness and nature of the nuclear arsenal.

Nuclear Abolition

When "A World Free of Nuclear Weapons" appeared in the editorial pages of the *Wall Street Journal* on 4 January 2007, many leading intellectuals took notice. Surprisingly, Shultz, Perry, Kissinger, and Nunn united in an effort to call for the end of nuclear weapons as soon as possible. That Nunn, a longtime advocate of nuclear nonproliferation, coauthored the article came as no surprise. Neither was it shocking that Perry, Pres. Bill Clinton's former secretary of defense, was calling for an end to the age of assured destruction. The same could not be said of former secretaries of state Kissinger and Shultz. Both served in Republican administrations during the Cold War and had a record of promoting American strength in the world. Exactly why these political icons joined together for the sake of reducing and eliminating nuclear weapons is debatable. What is apparent is that their editorial and the election of a new president reinvigorated opponents of nuclear weapons after eight years of clear disappointment.

In the two and a half years since the editorial ran, a myriad of reports and articles has echoed the same sentiment. The Arms Control Association, Center for Strategic and International Studies, Nuclear Threat Initiative, American Physics Society, and Sir Richard Branson's newly formed Global Zero have all followed suit with articles, conferences, reports, and advocacy supporting a nuclear-free world.[18] More recently, the November/December 2008 issue of *Foreign Affairs*, the nation's most influential foreign policy journal, published Daalder and Lodal's "The Logic of Zero," which explained in greater detail the thoughts of nuclear abolitionists.

While all of these men have proven themselves to be intelligent and thoughtful leaders with the best interests of the United States at heart, there are, however, fundamental problems with "A World Free of Nuclear Weapons," "The Logic of Zero," and similar articles advocating nuclear disarmament. The main arguments in these articles are representative of the broader debate and worthy of discussion.

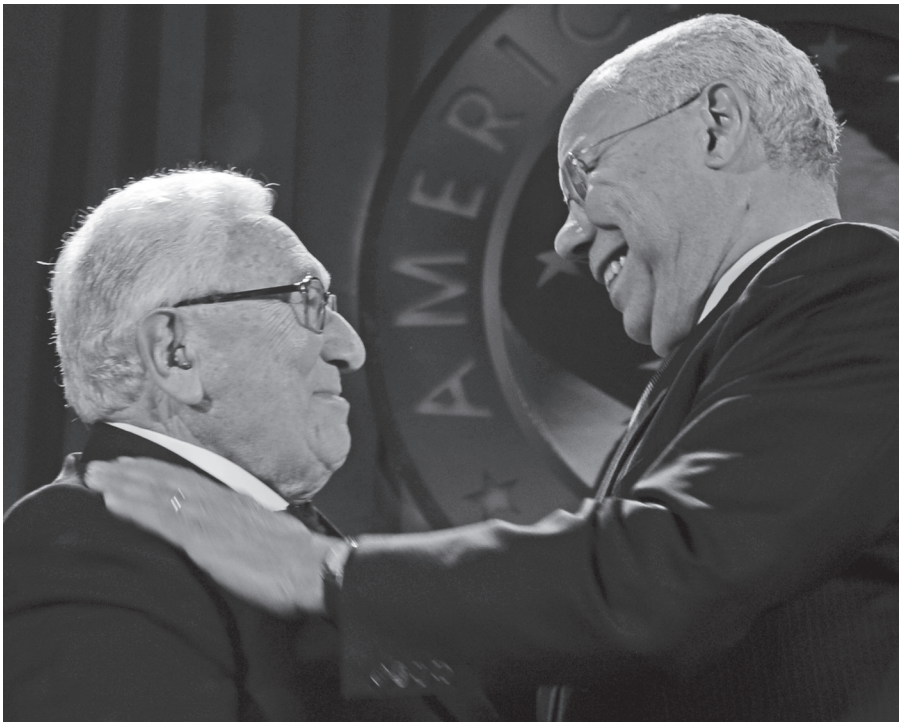

Figure 4. Retired US Army general and former secretary of state Colin Powell and Henry Kissinger at the Ronald Reagan Building in Washington, DC, 2 Dec 2008. (DOD photo by MSgt Adam M. Stump)

The Cold War Is Over

Nuclear abolitionists begin most articles by informing the reader that the Cold War is over. Shultz, et, al.,'s 2007 *Wall Street Journal* article reported, "Nuclear weapons were essential to maintaining international security during the Cold War because they were a means of deterrence. The end of the Cold War made the doctrine of mutual Soviet-American deterrence obsolete. Deterrence continues to be a relevant consideration for many states with regard to threats from other states. But reliance on nuclear weapons for this purpose is becoming increasingly hazardous and decreasingly effective."[19]

Daalder and Lodal are less generous in their description of the transition from the Cold War to the post–Cold War when they say, "The reality is yet to sink in. US nuclear policies remain stuck in the Cold War, even as the threats the United States faces have changed dramatically."[20]

These statements suggest that Presidents George H. W. Bush, Bill Clinton, and George W. Bush failed to understand the significance of the Cold War's end. This implication does not stand up against empirical analysis. The rationale for this view is largely based on criticism of the 1993 and 2001 NPR, which abolitionists suggest failed to fundamentally reform US nuclear weapons policy. They are, however, incorrect for several reasons. These policy documents, unilateral action by all three presidents and the START and SORT, significantly reformed American nuclear weapons policy by altering the size, targeting, posture, and justification for use of the nuclear arsenal.

In addition to faulting America's political leadership, abolitionists also question the strategic understanding of senior military officers with suggestions that they no longer understand the strategic environment and the role nuclear weapons play in national security.[21] Despairingly, it is said that general officers are "stuck in the Cold War" or are "looking for the next Cold War." Both statements are inaccurate and suggest unfamiliarity with the military and the quality of its leadership.

While abolitionists acknowledge the US nuclear stockpile has declined by 80 percent since 1991—declining from more than 24,000 warheads to around 5,000—as it moves from 2,200 to 1,700 by 2012, this is not seen as a fundamental shift

in nuclear weapons policy.[22] This view is incorrect for four primary reasons.

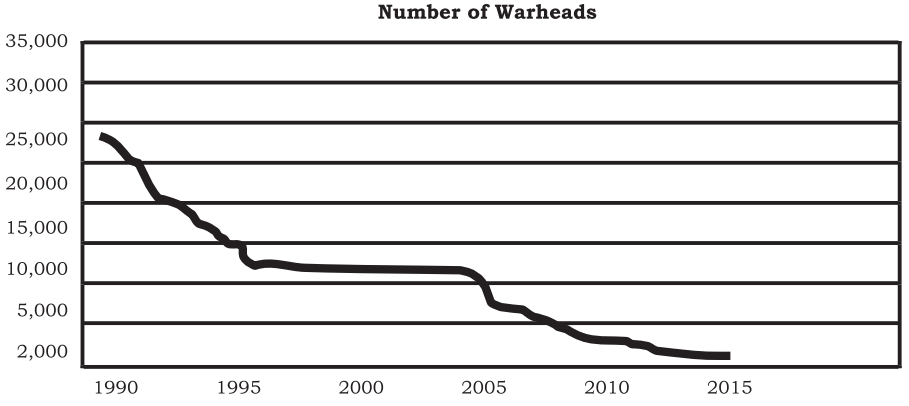

Figure 5. US nuclear stockpile is declining. (Adapted from a Federation of American Scientists fact sheet.)

First, the 80 percent reduction in operationally deployed strategic warheads achieved through START and SORT makes an approach to nuclear weapons policy—reliant on a survivable second strike—more difficult. Cold War policy began on the "assured destruction" concept which called for a secure second strike capability and an absence of defensive measures.[23] In order to carry out a second strike, it was necessary for the United States to possess enough strategic weapons to survive a first strike capable of destroying Soviet targets.

Since it was, and is, difficult to know if a Soviet first strike would destroy 10, 20, 50, or 90 percent of the US nuclear arsenal, past presidents erred on the side of caution. This meant the United States maintained a large nuclear arsenal as a hedge against a successful Soviet first strike. This was, in part, shaped by the fact that Americans found the idea of purposefully threatening the eradication of large numbers of civilians, even Soviets, unethical. US weapons were primarily targeted at Soviet nuclear missiles, bomber bases, and military targets.[24] This "counterforce" strategy required a greater number of nuclear weapons because the targets were often small and without a precise known location—a mobile nuclear missile for example—and sometimes protected in hardened facilities.

While a "countervalue" strategy targeting Soviet cities and infrastructure would have required fewer nuclear weapons, the United States still required a survivable second strike capability in order to maintain a credible deterrent.

With the continuing drawdown—under way for almost two decades—bringing the size of the nuclear arsenal down 90 percent by 2012, the assured destruction strategy that was the basis of Cold War nuclear policy is becoming untenable. Those who argue that a small number of nuclear weapons are sufficient operate on the assumption the United States would have a 100 percent success rate of "weapons on target" with a high kill ratio. There is little room for potential threats to the successful prosecution of a nuclear conflict, which include

- A first strike against the US nuclear arsenal
- Minuteman III and Trident II launch failures
- The shooting down of nuclear armed aircraft
- The sinking of SSBNs
- Incorrect targeting
- Detonation failures

A number of additional acts or circumstances arising in the fog and friction of war could prevent the United States from achieving perfection in nuclear weapons use. Thus, advocates of further reductions must account for the probability that a nuclear conflict will not go as planned.

It is important to understand the strategic significance of continued reductions. One shift is the required change in targeting strategy that is necessary to move to a small nuclear arsenal. A counterforce targeting strategy is difficult to sustain as fewer operationally deployed strategic nuclear weapons are available to allocate to military targets. This forces a shift to a countervalue targeting strategy and selection of civilian targets, which require far fewer nuclear weapons to hold the Russian, Chinese, or other nation's citizens at risk. Where the United States once targeted mobile Soviet missile launchers or remote Siberian missile bases—similar to US bases in Montana, North Dakota, and Wyoming—with multiple ICBM or bomber strikes,

the president will soon be forced to target Moscow and St. Petersburg because the arsenal includes too few weapons to effectively threaten Russian military targets. Drawdowns also force the Russians to make the same choice, pushing Atlanta, New York, Los Angeles, and other major cities to the top of the target list.

There can be little doubt that reductions in the nuclear arsenal size force a change in nuclear weapons policy. The potential dilemma created by further reductions is exacerbated when the lower yields of current warheads are taken into account. Not only are there fewer weapons, but they are less powerful. The real question remains, does the United States desire to back itself into a position where it must rely on a countervalue strategy and focus on the destruction of an adversary's population?

Second, the smaller the nuclear arsenal becomes, the fewer adversary countries the United States can reasonably expect to effectively hold at risk. This changes the cost/benefit calculation of an adversary who may desire to change the status quo. As the subjective theory of value suggests, with fewer nuclear weapons the United States is likely to place greater value on each weapon, raising the minimum requirement for their use.[25] Thus, the deterrent value of the nuclear arsenal is degraded as an adversary perceives the minimum standard for use to be higher.

And, if the United States continues to reduce the size of its nuclear force, an adversary is likely to view a first strike against the US nuclear arsenal as having a greater probability of success and a lower potential cost. For example, eliminating the ICBM force could reduce the Russian targeting problem in the continental United States to as few as six targets, greatly increasing the appeal of a first strike. By maintaining a large nuclear arsenal, the United States effectively raises the fee to enter the nuclear club as a peer, potentially dissuading prospective entrants. By reducing the arsenal to a number that is less difficult to achieve by the Iranians, for example, the entry fee is reduced and more nations view entry into the nuclear club as a viable option.

Third, a major shift in force structure is readily apparent. There can be little doubt that strategic and tactical nuclear forces are very different today than they were the day the Soviet Union collapsed. For example, the Peacekeeper, the newest

long range nuclear-capable missile the United States has developed, was retired from service in 2005.[26] The Minuteman III, a much older delivery system, has seen dramatic reductions in total numbers and the number of warheads deployed on each missile. It is of great significance to note that today's fleet of Minuteman IIIs (450) and B-52Hs (76) is far smaller than it was in 1990.

According to former secretary of defense William Cohen's 1998 *Annual Report to the President and the Congress*, the United States deployed 1,000 ICBMs and a fleet of 324 long-range bombers near the end of the Cold War.[27] If, as the earlier quote from Daalder and Lodal suggests, US military and political leaders are stuck in the Cold War, how do they explain the dramatic changes seen in the nuclear arsenal over the past 18 years? These reductions in the strategic force *clearly* demonstrate that political and military leaders were aware of a changing strategic environment.[28] With the perfect vision that hindsight provides, it is easy to criticize previous administrations, but to dismiss significant reforms the nuclear arsenal has undergone is unjustified.

It's All about Terrorism

The second argument advanced by abolitionists suggests, "In today's war waged on world order by terrorists, nuclear weapons are the ultimate means of mass devastation."[29] Daalder and Lodal argue, "A nuclear arsenal of many thousands of weapons will do nothing to deter terrorists from using a nuclear bomb should they acquire one; indeed the more nuclear weapons there are in the world, the more likely it is that terrorists will get their hands on one."[30] Without mischaracterizing the words of prominent abolitionists, it is accurate to say they believe the United States must disarm in order to encourage the remaining nuclear weapons states to follow suit—as will those states developing nuclear weapons. With nation-states disarmed, terrorists will not be able to acquire fissile material, which they can use to construct a nuclear bomb for use against the United States.

The logic of this idea is deeply problematic for several reasons. First, there is a lack of evidence to support the assertion

that the number of existing nuclear weapons correlates to the probability of terrorists acquiring a weapon or fissile material. A well secured stockpile of 10,000 warheads is far less a proliferation risk than one unsecured warhead. Focusing on the size of the nuclear stockpile is an obfuscation that does not directly address real security risks.

Figure 6. A Barksdale AFB, LA, weapons storage area. (USAF photo)

Second, the history of attempted arms control does not support the notion that the United States would be safer with fewer nuclear weapons. To the contrary, American disarmament is likely to be viewed by adversaries and terror networks as weakness and an opportunity to accomplish previous objectives absent American interference. The failure of the Washington Naval Treaty (1922) disarmament efforts after World War I played an important role in the remilitarization of the Axis powers in the 1930s and left the United States less prepared for World War II.[31] Then, as now, utopian views of a world without war left the United States without a credible military deterrent in the Pacific and, in part, led to the attack on Pearl Harbor.

Following the Cold War, many nonproliferation experts were shocked to learn that during the Cold War the Soviet Union, a

signatory to the Biological Weapons Convention, maintained an advanced biological weapons capability in violation of its treaty obligations.[32] Had the Soviets launched a biological attack against the United States, it is doubtful the nation could have effectively stopped or mitigated the effects since the United States did comply with its treaty obligations.

The wave of localized conflicts that followed the end of the Cold War may be indicative of a world free of nuclear weapons and the positive element of restraint they engender.[33] A survey of the historical record does not readily reveal an example of a great power willingly relinquishing an advanced military capability. Much less is there an example of a great power relinquishing an advanced military capability to promote peace and actually accomplishing that objective. Thus, if abolitionists win the current debate and the United States ultimately denuclearizes, it will be doing so contrary to the weight of considerable historical evidence which suggests that doing so will not create a more peaceful world.

In the ongoing struggle against international terror networks, it is important for the United States to maintain a superior capability in as many levels of conflict as possible. By doing so, nonstate actors are pushed lower and lower on what may be thought of as a "conflict pyramid," in which nuclear weapons serve as the capstone of conflict and small scale violence as the base. The lower down the pyramid the United States can force its adversaries, state or nonstate, the probability is lower that the nation will face an existential threat. Moving toward nuclear disarmament does not force terror networks further down the pyramid. Instead, it opens an opportunity for them to leapfrog to the top.

Abolitionists assume that terrorists desire nuclear weapons and, should they acquire them, will rush to use them in an attack.[34] Such an assumption may not be correct.[35] Adversaries of the United States do not choose terrorism from a full range of military options. Instead, American dominance in all other domains creates a set of circumstances in which terrorism becomes the only viable option for an adversary. As Mao Tse-tung describes in his manual for conducting guerrilla warfare, terrorism is not an end in itself but a tactic of the weak. Victory in a conventional conflict is the ultimate military objective of a

weaker adversary, including terrorists.[36] It is, however, not an option. Suggesting that terrorists are, by definition, irrational demonstrates a shallow understanding of the principles, objectives, and tactics of terror networks.[37]

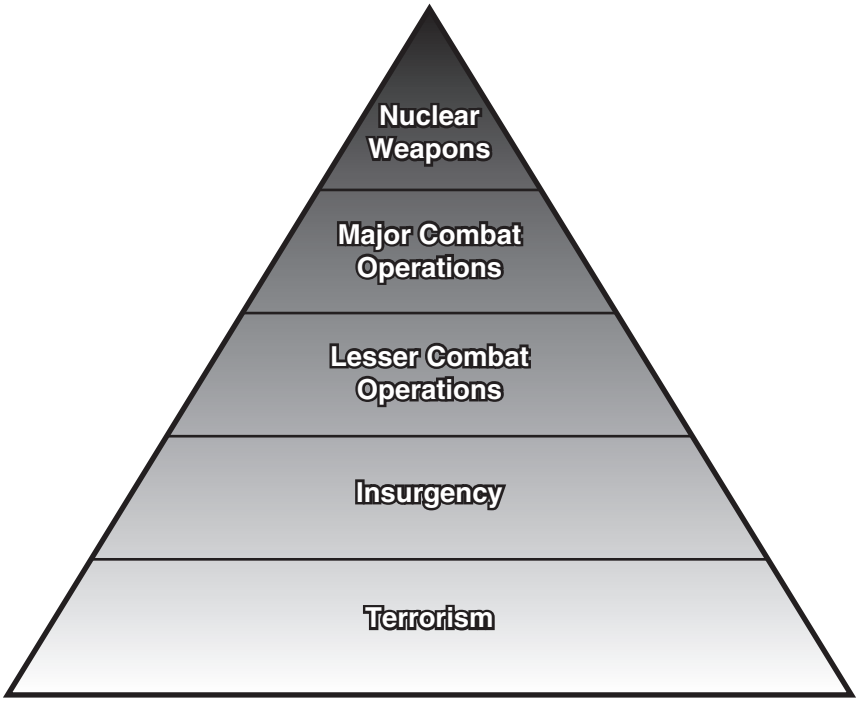

Figure 7. Conflict pyramid. (Created by author)

If terrorists were to acquire a nuclear weapon, it would be more useful as a tool for blackmail or propaganda than as a weapon of mass destruction in a single terror attack. Terrorists seek to change the status quo by targeting noncombatants who can then shift the policies of their government. Al-Qaeda threatening to use a nuclear weapon is far more powerful than actually using it. For example, Americans may pressure their government to change its policy if threatened. However, Cerberus, guardian to the gates of Hades, could not stop an American invasion of the underworld once a nuclear weapon was used against the United States.

Third, abolitionists contend that American conventional capabilities are a substitute for nuclear weapons and are better suited for fighting terrorism. The Bush administration's "new triad" was built, in part, on the belief that precision-guided munitions (PGM) can hold the same targets at risk that once required nuclear weapons.[38] While this is technically correct, nuclear weapons are valuable because of the psychological effect they generate, which is not replicated by PGMs. If, however, this line of reasoning is carried to its logical conclusion, it would require the United States to move toward the elimination of advanced conventional capabilities for reasons similar to those offered as a rationale for eliminating nuclear weapons.

In fact, there is little reason and a conspicuous lack of historical evidence to suggest the world will be safer without nuclear weapons. It is only because America's adversaries are well aware of their inability to match American conventional capabilities that nuclear weapons are an attractive option. Fear of American conventional forces is a driving force behind nuclear weapons programs in North Korea and Iran, not the fear of America's nuclear arsenal.[39] Suggesting that an American move toward nuclear disarmament will lead to adversaries disarming ignores recent history. A move by the United States to disarm may, in fact, have the undesired effect of spurring nuclear development by US adversaries since the bar for reaching parity will be lower. Thus, it is problematic when Daalder and Lodal claim, "Today, the gravest threat comes from the possibility of terrorists bent on delivering a devastating blow against the United States acquiring the capacity to do so with nuclear weapons."[40] They are wrong in suggesting that a nuclear attack by terrorists is the gravest threat this country faces. The Russian and Chinese nuclear arsenals remain a far greater potential threat.

While it is true that a future terrorist attack on the United States is a greater probability, such an attack is not an existential threat. The same cannot be said of a large scale nuclear attack on the United States by a nuclear peer.

Conventional and nuclear weapons are different—very different. If this was not the case, why was 9 August 1945 the last time a nuclear weapon was used in war? This rare usage cannot be claimed by any conventional weapon. As Ellen Collier of the Congressional Research Service illustrated, the Cold War was

rife with conventional conflicts in which the United States was constantly engaged.[41] The same is true of the post–Cold War period. If there is a lesson to be learned from the Cold War, it is the periodic failure of conventional deterrence.

The level of destruction accompanying a nuclear detonation generates a level of awe and fear that cannot be replicated by any other weapon. This may be the result of watching grainy footage from nuclear tests or the striking images of Hiroshima and Nagasaki. Or, it may be a just fear of the radiological after-effects that can follow a nuclear explosion. Whatever the case may be, nuclear weapons have a deterrent effect that cannot be re-created with conventional capabilities. Absent nuclear weapons and a credible strategy for their use, the United States will lose much of its ability to serve as a force of stability in an unstable international system.

Moving to One Thousand

While abolitionists desire the complete elimination of nuclear weapons, they are more modest in their immediate objectives. Some reports offer 500 or 1,000 as the right number of operationally deployed strategic nuclear warheads. However, it is not clear why these are the appropriate numbers, other than to say, "This would be more than enough to convince anyone that the United States possesses the capacity to respond to any use of nuclear weapons with devastating effect."[42] Currently, the United States is moving to the 1,700–2,200 operationally deployed strategic nuclear weapons established in the 2002 Moscow Treaty, taken from a Pentagon study on post–Cold War requirements for an effective deterrent.[43]

Choosing an arbitrary number (500, 1,000, or 1,500) is not an optimal approach to sizing the nuclear arsenal. Instead, the size, delivery systems, and manner of deployment should be based on potential threats to national security. As the threat posed by nuclear adversaries increases, it may be prudent to expand the nuclear arsenal. If the international environment stabilizes and the number and level of threats decline, the arsenal can shrink. As history demonstrates, it is far more difficult to expand the nuclear arsenal than it is to reduce it. Thus,

a floor may be appropriate for the number of warheads and delivery vehicles.

Perhaps more importantly, the United States must always pay careful attention to maintaining a credible nuclear deterrent, which encompasses more than a simple numeric calculation. Even with 500, 1,000, or 1,500 warheads, as the abolitionists suggest, the United States may not be perceived as a nation willing to use its nuclear weapons, particularly for nonvital national interests. There is no one-to-one ratio between warheads and credibility with an increase in warheads leading to a corresponding increase in credibility. It is, however, difficult to develop a more effective way of undermining American credibility than to

- Arbitrarily reduce the size of the nuclear arsenal,
- Reduce the triad to a monad, and
- Stop investing in the modernization of warheads and delivery systems.

This sends a signal to allies and adversaries alike—US nuclear deterrence is not credible. In the aftermath of nuclear arms reductions, America's adversaries are likely to start or continue their current nuclear weapons development, much like North Korea and Iran, as a counter to American conventional capabilities.

Allies protected by America's extended deterrence may view a diminished arsenal as a sign that the United States cannot and will not fulfill its obligations. A new era of proliferation among advanced industrialized nations may be the result. Britain and France have long maintained a hedge against the failure of extended deterrence and, as of late, are undertaking nuclear modernization programs.[44] Japan may be the first US ally to develop its own nuclear weapons capability as American numbers and credibility decline.[45] Rather than encouraging disarmament, the United States may inaugurate a new era of nuclear proliferation if it continues to disarm.

Perhaps it is time to develop a process by which the nation determines the appropriate number of deployed and reserve warheads. In order to arrive at a better approximation, it may be appropriate to answer seven questions.

- What are the threats/scenarios facing the United States and allies reliant on extended deterrence?
- What are the objectives America's adversaries are seeking to achieve?
- Will nuclear weapons contribute to deterrence? How?
- Is a countervalue or counterforce strategy more appropriate?
- How survivable are US nuclear forces?
- What are the targets and by what delivery platform are they best held at risk?
- What are the consequences of being wrong?

While there are certainly more variables to consider, answering these questions begins to provide some structure for determining the appropriate size and method of delivery for the nuclear arsenal.

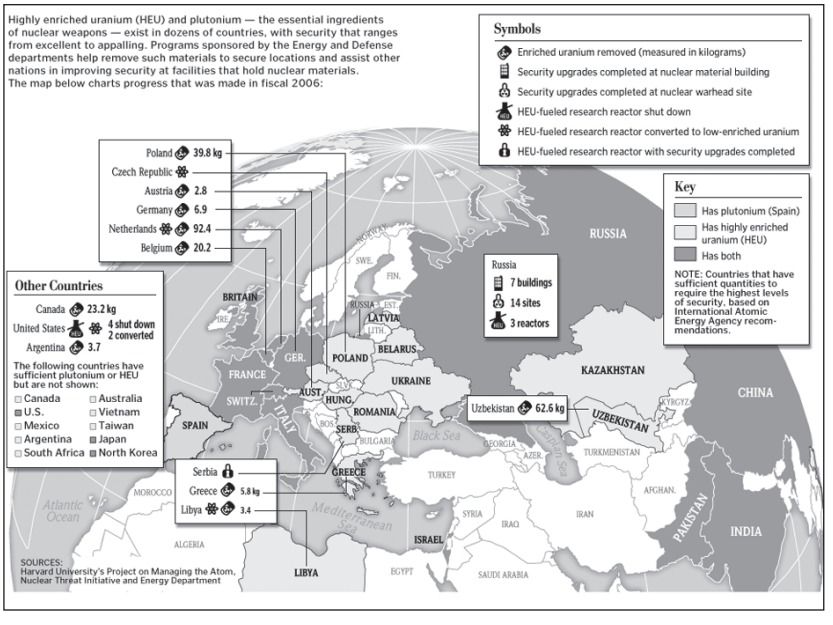

Figure 8. Highly enriched uranium and plutonium—the essential ingredients of nuclear weapons—exist in dozens of countries. (Reprinted from Harvard University's Project on Managing the Atom, Nuclear Threat Initiative, and the Department of Energy.)

Somewhat surprisingly, "The Logic of Zero" says nothing of a current or future nuclear threat posed by potential adversaries. Gestures of peace from the United States rarely solicit the desired response. This is particularly true of the relationship between the United States and Russia, dating back to Joseph Stalin's betrayal of Franklin D. Roosevelt in Poland and Eastern Europe after World War II.[46] This was not the last time an agreement was violated. As the Arms Control Association has noted, the Soviet Union and, now, Russia have a history of violating the Biological Weapons Convention, making it difficult to place much faith in a future agreement on nuclear disarmament.[47] American distrust of Russia is well founded and illustrated in the 1992 Bush administration decision to maintain a large nuclear stockpile as a hedge against a return to authoritarianism.[48] Recent developments in Russian politics give reason for concern and may signal the rise of illiberal democracy and the end of the Russian bear's hibernation.[49]

In addition, Russia believes its nuclear arsenal is vital to its national security for three reasons. First, nuclear weapons are prestigious to possess. It should not be forgotten that the Soviet Union was once the largest empire on the earth, which most Russians remember. Second, Russian nuclear weapons deter the United States from interfering in Russian affairs, such as the recent conflict with Georgia. Third, the Russian army cannot stop or deter a feared "Chinese expansion" into eastern Siberia without nuclear weapons.[50] Suggesting that Russia will follow the United States in disarming is to suggest that Pres. Dmitry Medvedev and the Right Honorable Vladimir Putin, prime minister of Russia, will alter their recent behavior. This is unlikely.

It may also be useful to note that Russia maintains a tactical nuclear arsenal of more than 3,000 warheads which can be used to threaten Europe or China.[51] Neither START nor SORT limits Russia's tactical nuclear weapons. Tactical, not strategic, nuclear weapons will play a greater role as a guarantor of Russian security as Russia looks closer to home for future threats. To view President Medvedev's willingness to negotiate down the number of strategic nuclear weapons leads to a false sense of accomplishment since Russia will maintain the tactical nuclear weapons it is increasingly valuing.

Figure 9. Vladimir Putin, Russian prime minister. (DOD photo by Cherie A. Thurlby)

Figure 10. Nuclear blast. (DOD photo by LCpl D. N. Crosser)

Accidental Detonation, Miscalculation, and Nuclear Proliferation

The next line of abolitionist argumentation focuses on the potential for accidental detonation, miscalculation leading to a nuclear holocaust, and proliferation. While it is true these risks do exist, in the 60-year history of nuclear weapons, there has never been an accidental detonation much less a nuclear holocaust.

Suggesting these events are inevitable is ahistorical. Current nuclear controls separate arming codes and weapons handlers/launch officers until a presidential decision is made, requiring multiple levels of verification before a weapon can be armed and released. If the United States was to pursue the RRW, accidental detonation would be even less likely. This is also true of current modernization efforts taking place in Russia and China.[52]

Additionally, American and Russian ICBMs are no longer targeted at each another. Programming target sets requires time,[53] and ICBMs no longer sit on "launch on warning" status.[54] The notion that ICBMs sit on a "hair trigger" alert is not correct and never was. Thus, from a technical perspective, the probability of rapid, cataclysmic miscalculation leading to a nuclear holocaust is highly improbable.

With more than 60 years of nuclear weapons experience, there is also a low probability of political miscalculation. Neither the president of the United States nor his counterpart in Moscow has ever "miscalculated" and launched a nuclear weapon. Rather than expecting miscalculation, a better approach may be to assist other nuclear powers in developing the sound practices that have led to six decades of American and Russian restraint.

Finally, it is not in the interests of any state, including Iran, to transfer nuclear material and know-how to violent Islamic fundamentalists. To the contrary, it is in Iran's interest to ensure that groups, such as Hezbollah, have a limited capability for waging war. Much as Saddam Hussein[55] was careful to limit his assistance to terrorist groups because he feared they could turn against him, Iran has limited its assistance to Hezbollah.[56] As the Nuclear Threat Initiative suggests in its recent work, the

potential for proliferation, particularly in Russia, is on the decline as it improves controls over key items and personnel.[57] As the United States continues to improve its nuclear forensics capability—ensuring the world knows of its capacity to track material—adversaries, state and nonstate, will face an increasing level of risk should they desire to launch a covert nuclear attack against the United States.

Figure 11. A Minuteman III missile. (USAF photo by TSgt Bob Wickley)

Among nuclear powers, Pakistan presents the greatest proliferation risk. This risk was mitigated by former president Pervez Musharraf who successfully established positive control over Pakistan's nuclear stockpile.[58] As a result of the discovery of Abdul Qadeer Khan's illicit trafficking network, security measures were substantially improved.[59] Counter to what some may think, a nuclear Iran would likely pose less of a proliferation risk than Pakistan. With a stable central government and a long history of working with terrorist organizations, the Iranian political elite are experienced with internal security. While they may be professed enemies of the United States, the Iranian regime does not seek its own destruction.

The difficulty in demonstrating the positive outcome of nuclear weapons is, by definition, based on the fact that they are designed and utilized to deter an adversary. Developing a chain of causality for successful deterrence is next to impossible to build. Therefore, the potential negative implications of nuclear weapons remain the focus, rather than their history of preventing conflict. Although it is impossible to demonstrate beyond a reasonable doubt, it is logical to suggest that the relationship between two enduring rivals was changed for the better with their acquisition of nuclear weapons.

India's response to the 26–29 November 2008 Mumbai terrorist attack is a good example of the moderating effect nuclear weapons have on the behavior of nuclear-armed adversaries. Prior to developing nuclear weapons, India and Pakistan fought one another in the First Kashmir War (1947), Second Kashmir War (1965), and the Indo-Pakistani War (1971), along with numerous terrorist attacks and artillery exchanges over the decades.[60] Lashkar-e-Taiba's attack left 172 innocent civilians dead and placed the Indian government under tremendous pressure to respond with overwhelming force, yet the Right Honorable Manmohan Singh, prime minister of India, showed great restraint that can only be attributed to the fear of a conventional conflict escalating to full-scale nuclear war. While India would likely win a conventional conflict with Pakistan, neither country is willing to take such a risk.[61] These two rivals are not the only examples of the moderating influence of nuclear weapons.

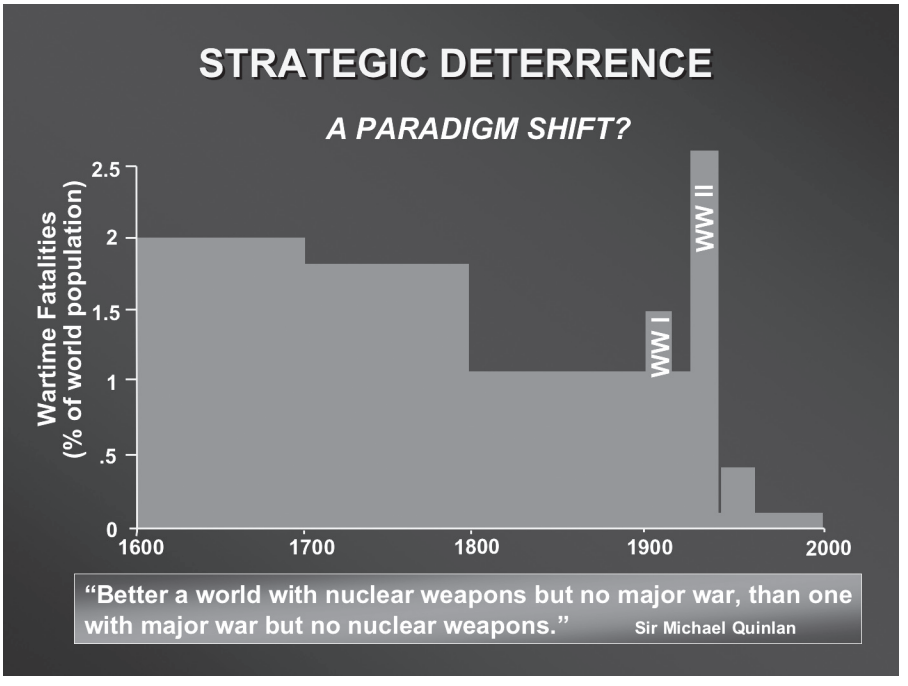

Figure 12. Percentage of world population killed in war. (Reprinted from a briefing by retired admiral Richard Meis.)

The Cold War provides the single best example of successful nuclear deterrence, although this proposition is admittedly difficult to verify. It is, however, clear that an estimated eight million deaths resulted from World War I and another 55–70 million deaths from World War II.[62] After the United States dropped atomic bombs on Hiroshima and Nagasaki, saving the lives of an estimated 500,000–1,000,000 American troops, the world has not seen another major war.

Luck

Finally, abolitionists account for the lack of a nuclear holocaust by pointing out that "responsible nuclear stewardship, a relatively effective nonproliferation regime, and a good deal of luck have helped account for this achievement. But the world cannot continue to count on luck."[63] As with the previous

points, evidence to substantiate America's reliance on luck is lacking. If past successes are the result of luck, how much more will the United States rely on luck once it disarms? Should the United States disarm, it will no longer be able to lay claim to Flavius Vegetius' dictum, "*Si vis pacem, para bellum*" (If you wish for peace, prepare for war).

Moving beyond Criticism of Nuclear Abolition

If the modernizers are to successfully persuade the president, a skeptical Congress, and the American people that a safe, modern, and reliable nuclear arsenal is needed, they must begin by directly addressing the arguments of nuclear abolitionists. Relying on unengaging technical reports to make the case for the nuclear arsenal is not a strategy for success. Instead, four mutually reinforcing approaches may offer a viable opportunity to preserve the nuclear arsenal while also accomplishing legitimate nonproliferation objects.

First, the United States remains a representative republic where the American people have the single most important voice in determining public policy. Modernizers would be wise to engage Americans in an effort to inform them about deterrence and nuclear weapons policy. The importance of winning the support of the American people should never be underestimated. One effective way to accomplish this objective is for senior leaders and scholars in the modernization camp to support journalists who seek to better understand nuclear weapons operations and policy, as well as publish editorials in major newspapers, leading Web sites, and appear on television regularly to discuss the issue. Taking complex issues and turning them into brief and informative columns can be effective. Where abolitionists appeal to emotion, modernizers must appeal to reason. It is with the financial resources of the citizenry that modernizers are constitutionally tasked to preserve the nation's security.

Second, Congress is responsive to the demands of constituents. If modernizers effectively persuade the American people, individual members of the House and Senate will respond by supporting DOD efforts to build and maintain a safe, secure, and modern nuclear arsenal. Passive effort is, however, not enough.

An active effort should be undertaken to educate the military legislative assistants of each member of Congress. Rather than focusing on program objective memorandum issues, a broader understanding of deterrence and nuclear weapons should be the focus of educational efforts. The reluctance of Congress to support the RRW and other modernization efforts is a failure to effectively make a compelling case for modernization.[64] Success will depend on persuading congressional leaders with strong arguments that overcome the emotional and speculative arguments of abolitionists.

Third, modernizers must work to persuade the president of the nuclear arsenal's continuing importance to national security. As with every new administration, the realities of office overcome the rhetoric of the campaign. President Obama can be convinced that a safe, secure, and modern nuclear arsenal is the best way to protect the American people and promote peace and stability internationally. As with the American people and Congress, success will be determined by the strength of the argument presented to the president. Convincing President Obama is made much easier if the American people and Congress are already supportive of the policies advocated by modernizers.

Finally, every effort should be made to find potential common ground with abolitionists. While it is highly unlikely they will be persuaded of the utility of the nuclear arsenal, there are areas where potential collaboration is possible. As in the past, the United States and advocates of modernization can support international efforts to assist in nonproliferation efforts such as maintaining an effective command-and-control system in all nuclear weapons states, improving fissile material and nuclear stockpile security, and similar measures.

Pursuing a course of action that is grounded in a well-thought-out approach to US national security and supported by both theory and practice should prove successful, but it will require modernizers to vigorously defend their efforts. The alternative, however, is to allow the utopian dreams of nuclear abolitionists to put the security of the American people at risk. That is unacceptable.

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61. Mubashir Zaidi and Laura King, "Mumbai Attacks Could Chill India-Pakistan Ties," *Los Angeles Times*, 28 November 2008, http://www.latimes.com/news/nationworld/world/la-fg-pakistanblame29-2008nov29,0,5153422.story?track=rss.

62. Colin Nicholson, *The Longman Companion to the First World War* (New York, NY: Longman, 2001), 248; and I. Dear and M. Foot, eds., *The Oxford Companion to World War II* (Oxford: Oxford University Press, 2002).

63. Daalder and Lodal, "Logic of Zero."

64. Ike Skelton and Ellen Tauscher, "Letter: Administration Nuclear Weapons Policy Statement," *House Armed Service Committee*, 26 July 2007, http://armedservices.house.gov/list/press/armedsvc_dem/skeltonpr072607.shtml.

Appendix

Complete List of All US Nuclear Warheads

Designation	Deployment Status
Mk-I	Used in combat in 1945, never stockpiled; only five bomb assemblies completed, all retired by Nov 1950
Mk-III	Used in combat in 1945; mass production 4/47–4/49, 120 produced; all retired late 1950
Mk-4	Entered service 3/49; produced 3/49–5/51; 550 produced (all models); retired 7/52–5/53
T-1 / TX-1	Entered service, withdrawn, late 1940s
Mk-5	Entered operational stockpile 5/52; last retired 1/63; 140 bombs (all models) produced
W-5	Start of manufacture 4/54 (Regulus), 7/54 (Matador); retired 7/61–1/63; 35 (Regulus), 65 (Matador) produced
Mk-6	Manufactured from 7/51 to early 1955; 1,100 bombs (all models) produced; last retired 1962
Mk-7	Manufactured 7/52–2/63; in service July 1952–67; 1,700–1,800 produced
W-7	W-7 warhead manufacture begun 12/53; BOAR: stockpiled 1956–63, 225 produced; Corporal: stockpiled 1955–65, 300 produced; Honest John: stockpiled 1954–60, 300 produced; ADM: stockpiled 1955–63, 300 produced; Betty: stockpiled 6/55–1960, 225 produced
Mk-8	Manufactured 11/51–5/53; in service 1/52–6/57; 40 produced (all models)

Designation	Deployment Status
W-9	Manufactured 4/52–11/53; retired 5/57; 80 produced
Mk-9/T-4	Stockpiled 1957; retired 1963
Mk-11	Manufactured 1/56–1957; in service 1/56–1960; 40 produced
Mk-12	Manufactured 12/54–2/57; retired 7/58 –7/62; 250 produced
TX/Mk-14	Stockpiled 2/54–10/54; five produced
Mk-15	Manufactured 4/55–2/57; retired 8/61–4/65; 1,200 produced (all models)
TX-16	Stockpiled 1/54–4/54; five produced
EC-17	Stockpiled 4/54–10/54; five produced
Mk-17	Manufactured 7/54–11/55; retired 11/56–8/57; 200 produced
Mk-18	Manufactured 3/53–2/55; retired 1/56–3/56; 90 produced (all models)
W-19	Production began 7/55; retired 1963; 80 produced
Mk-21	Manufactured 12/55–7/56; retired 6/57–1/57; 275 produced (all models)
W-23	Production began 10/56; retired 10/62; 50 produced
EC-24	Stockpiled 4/54–10/54; 10 produced
Mk-24	Manufactured 7/54–1/55; retired 9/56–10/56; 105 produced
W-25	Manufactured 5/57–5/60; Mod 0 retired 8/61–1965, all retired by 12/84; 3,150 produced (all models)

Designation	Deployment Status
Mk-27	Manufactured 11/58–6/59; retired 11/62–7/65; 700 produced (all models)
W-27	Manufactured 9/58–6/59; retired 8/62–7/65; 20 produced
Mk-28	Manufactured 1/58–3/58, 8/58–5/66; retirement of early models began 1961, last one retired 9/91; 4,500 produced (all models)
W-28	Manufactured 8/58–5/66, entered service (Hound Dog) 1959 and (Mace) 1960; Hound Dog retired 1/64–1976, Mace retired 1970; production: 900 (Hound Dog), 100 (Mace)
W-30	TADM: stockpiled 1961–1966, 300 produced; Talos: manufactured 2/59–1/65, retired 1/62–3/79; 300 produced
W-31	Honest John: manufactured 10/59–12/61, retired 7/67–1987, 1,650 produced; Nike Hercules: manufactured 10/58–12/61, retired 7/67–9/89, 2,550 produced; ADM: stockpiled 9/60–1965, 300 produced
W-33	Manufactured 1/57–1/65; retired 9/92; 2,000 produced
W-34	ASW: Manufactured 8/58–12/62; retired 7/64–1971 (Lulu), 7/64–1976 (Astor); 2,000 Lulu, 600 Astor produced; Hotpoint: manufactured 6/58–9/62; retired by 1965; 600 produced
Mk-36	Manufactured 4/56–6/58; retired 8/61–1/62; 940 produced (all models)
W-38	Manufactured 5/61–1/63; retired 1/65–5/65; production: 110 (Atlas), 70 (Titan)

Designation	Deployment Status
Mk-39	Manufactured 2/57–3/59; retired 1/62–1/66; 700 produced (all models)
W-39	Redstone: stockpiled 7/58–1963; 60 produced; Snark: manufactured 4/58–7/58, retired 8/62–9/65; 30 produced
W-40	Bomarc: manufactured 9/59–5/62, retired by 11/72; 350 produced; Lacrosse: manufactured 9/59–5/62, retired 10/63–1964; 400 produced
Mk-41	Manufactured 9/60–6/62; retired 11/63–7/76; 500 produced
Mk-43	Manufactured 4/61–10/65; retirement (early models) began 12/72, last retired 4/91; 1,000 produced (all models)
W-44	Manufactured 5/61–3/68; retired 6/74–9/89; 575 produced
W-45	Terrier: manufactured 4/62–6/66, retired 7/67–9/88; 750 produced; MADM: manufactured 1/62–6/66, retired 7/67–1984; 350 produced; Bullpup: manufactured 1/62–1963, retired 7/67–1978; 100 produced; Little John: manufactured 9/61–6/66, retired 7/67–1970; 500 produced
W-47	EC-47 manufactured 4/60–6/60, retired 6/60; 300 produced; W-47 manufactured 6/60–7/64, retired 7/61–11/74; 1,060 produced (Y1 and Y2)—only 300 in service at a time
W-48	Manufactured 10/63–3/68; retired (135 Mod 0s) 1/65–1969, all 925 Mod 1s retired 1992; 1,060 produced (all models)

Designation	Deployment Status
W-49	Manufactured 9/58–1964; Thor retired 11/62–8/63 (a few to 4/75)
W-50	Manufactured 3/63–12/65; retired 4/73–4/91; 280 produced
W-51	Became XW-54 Jan 1959
W-52	Manufactured 5/62–4/66; retired 3/74–8/78; 300 produced
Mk-53	Manufactured 8/62–6/65; retirement (early models) began 7/67, last 50 retired from active service (but retained in permanent stockpile) early 1997; 350 produced, 50 still in stockpile
W-54	Manufactured 4/61–2/65; retired 7/67–4/72; 1,000–2,000 produced
Mk-54	Manufactured 4/61–2/65; retired 7/67–1971; 400 produced
Mk-54 SADM	Manufactured 8/64–6/66; retired 1967–1989; 300 produced
W-55	Manufactured 1/64–3/68, 3/70–4/74; retired 6/83–9/90; 285 produced
W-56	Manufactured 3/63–5/69; retired 9/66 (early models), Mod-4 retired 1991–1993; 1,000 produced (all models), 455 Mod-4s produced
Mk-57	Manufactured 1/63–5/67; retirement (early models) started 6/75, last retired 6/93; 3,100 produced
W-58	Manufactured 3/64–6/67; retired 9/68–4/82; 1,400 produced
W-59	Manufactured 6/62–7/63; retired 12/64–6/69; 150 produced

Designation	Deployment Status
Mk/B61	Manufactured 10/66–early 90s; early models retired 70s–80s; 3,150 produced, 1,350 in service
W-62	Manufactured 3/70–6/76; early models retired starting 4/80; 1,725 produced, 610 in active service
W-66	Manufactured 6/74–3/75; retired from service 8/75, retired from stockpile 1985; 70 produced
W-68	Manufactured 6/70–6/75; retired 9/77–1991; 5,250 produced
W-69	Manufactured 10/71–8/76; retired 10/91–9/94; 1,500 produced
W-70	Manufactured 6/73–7/77 (Models 0-2), 8/81–2/83 (Mod 3); retired 7/79–9/92; Models 0-2: 900 produced, Mod 3: 380 built
W-71	Manufactured 7/74–7/75; retired 1975, retired from stockpile 9/92; 30 produced
W-72	Manufactured 8/70–4/72; retired 7/79–9/79; 300 produced
W-76	Manufactured 6/78–7/87; active service; approx. 3,000 produced
W-78	Manufactured 8/79–10/82; active service; 1,083 produced, 920 in service
W-79	Manufactured 7/81–8/86; ER version retirement started mid-80s, all retired 9/92; 550 (325 ER, 225 fission) produced
W-80-0	Manufactured 12/83–9/90; active service; 367 produced
W-80-1	Manufactured 1/81–9/90; active service; 1,750 produced, 1,400 in service
W-82	W-82-0 canceled in October 1983; W-82-1 canceled in September 1990

Designation	Deployment Status
B-83	Manufactured 6/83–1991; active service; 650 produced
W-84	Manufactured 9/83–1/88; inactive stockpile; 300–350 produced
W-85	Manufactured 2/83–7/86; retired 1988–3/91; 120 produced
W-87	Manufactured 7/86–12/88; active service; 525 produced
W-88	Manufactured 9/88–11/89; active service; 400 produced

Adapted from *Nuclear Weapons of the United States* by James N. Gibson, 1996.

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