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The current threat to the U.S. is vastly different than the threat faced during the Cold War. While today's dynamic international climate requires less dependence on nuclear weapons, they remain critical to national security so long as they are also possessed by another nation. A long-term nuclear policy is needed to emphasize the U.S. desire to reduce the number of weapons, but also to provide meaningful guidance and resourcing that emphasizes a highly-capable enterprise to provide national security. It is impossible to determine what threats the U.S. will face over the next 20 years, but it is unlikely the world will be free of nuclear weapons.

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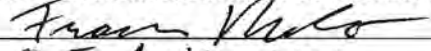
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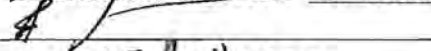
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Executive Summary

Title: U.S. Nuclear Weapons Enterprise: A Strategic Past and Unknown Future

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Thesis: In 1945, nuclear weapons became a fundamental basis of US national defense strategy and power projection, but a failure to adapt to the post-Cold War era has left the U.S. government with a crumbling nuclear weapons enterprise and an outdated nuclear weapons policy that no longer provides a credible nuclear deterrence.

Discussion: The United States (U.S.) led the world into the age of nuclear warfare as it developed, deployed and detonated the atomic bomb. Beginning in 1941, the U.S. prioritized and committed its financial, intellectual, political and diplomatic resources in the race to obtain nuclear superiority over Germany and Japan during World War II, and then the Soviet Union during the Cold War. The U.S. remained committed to its nuclear arsenal until 1991 when the Cold War ended and the government and DoD shifted its focus to conventional conflicts with a decreased likelihood of nuclear involvement. This shift and the difficulty of creating a nuclear policy that addressed the changing geo-political and military realities made nuclear weapons politically unpopular.

The 2007 and 2008 nuclear incidents involving the U.S. Air Force uncovered the systemic challenges facing the DoD nuclear enterprise. Beginning in 2001, the DoD reprioritized its efforts to combat an increasingly conventional threat for which nuclear weapons were not longer suited to deter. Major restructuring of nuclear forces and commands led to a fragmented nuclear enterprise that lacked proper oversight and resourcing. Nuclear deterrence had become a theory, but was no longer a cornerstone of U.S. national security.

Nuclear deterrence policy evolved over the decades to match the threat to the nation. While it was well suited for the Soviet threat, the policy was never prioritized and updated after the end of the Cold War. Since 1991, the U.S. has made significant cuts to its nuclear arsenal but has failed to establish a long-term, articulated policy that matched the current political environment. Because of this, the nuclear enterprise has no long term strategy to fund, resource and create a next-generation capability that will be well suited to the international political environment and capable of dissuading future threats.

Conclusion: The current threat to the U.S. is vastly different than the threat faced during the Cold War. While today's dynamic international climate requires less dependence on nuclear weapons, they remain critical to national security so long as they are also possessed by another nation. A long-term nuclear policy is needed to emphasize the U.S. desire to reduce the number of weapons, but also provide meaningful guidance and resourcing that emphasizes a highly-capable enterprise to provide national security. It is impossible to determine what threats the U.S. will face over the next 20 years, but it is unlikely the world will be free of nuclear weapons.

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“The fact is that nuclear weapons exist and the knowledge of how to make them cannot be erased. Conventional weapons have never been enough to deter war. Two world wars showed us that.”

Margaret Thatcher, Mar 30, 1987, the Kremlin

NUCLEAR CHALLENGES IN A POST COLD-WAR ENVIRONMENT

The United States (U.S.) led the world into the age of nuclear warfare as it developed, deployed and detonated the first atomic bomb. Beginning in 1941, the U.S. prioritized and committed its financial, intellectual, political and diplomatic resources in the race to obtain nuclear superiority over Germany and Japan during World War II, and then the Soviet Union during the Cold War. The U.S. remained committed to its nuclear arsenal until 1991 when the Cold War ended and the government and Department of Defense (DoD) shifted their focus to conflicts with a decreased likelihood of nuclear involvement. This reprioritization and the difficulty of creating a nuclear policy that addressed the changing geo-political and military realities made nuclear weapons politically unpopular and have left the nuclear weapons enterprise without an adequate long-term strategy. Since 1945, nuclear weapons have formed the fundamental basis of U.S. national defense strategy and power projection, but a failure to adapt to the post-Cold War era has left the U.S. government with a crumbling nuclear weapons enterprise and an outdated nuclear weapons policy that no longer provides a credible nuclear deterrence.

A synchronized U.S. nuclear policy began to take shape in 1954 with the announcement of “massive retaliation” and evolved through the end of the Cold War. The fall of the Soviet Union created an opportunity to reexamine U.S. nuclear policy, the nuclear weapons enterprise, and the nuclear triad. Since there is no longer the threat of imminent nuclear war, the enterprise has struggled with its perceived relevancy in today’s post-Cold War environment. For nearly two decades, presidents have successfully reduced the number of fielded, operational warheads but failed to articulate a long-term policy that matched the current geo-political climate. Without a policy to guide an adaptive strategy, congress has been unwilling to provide appropriate

funding and the U.S. is left with a smaller Cold War era force that does not reflect the requirements of the current international environment and has no clear path for the future.

Over the last 20 years, the nuclear community within the DoD and Department of Energy (DoE) has experienced diminishing support and advocacy from the U.S. government. Decades of neglect has left the nuclear community with a cadre of professionals amidst a culture of increased complacency and diminishing expertise. The weapon systems and infrastructure lack advocacy in budgetary considerations, future sustainment, personnel expertise and training, and are perceived as less relevant to the nation's defense as deterrence is now considered less important after the Cold War.

A series of spectacular failures in 2007 and 2008 highlighted the decline of the U.S. nuclear mission and demanded DoD reprioritize its focus and effort on the nuclear community. Investigations of the incidents concluded that the DoD and DoE face significant long-term challenges to the nuclear enterprise in the post-Cold War environment due to a lack of cogent policy, leadership, organizational culture and nuclear expertise. These incidents merely highlight the need for capable leadership, increased funding, sufficient prioritization and executive-level oversight.

The intercontinental ballistic missile (ICBM), B-52 and B-2 nuclear-capable bombers, and nuclear submarines are iconic symbols of the Cold War that remain relevant weapon systems, providing America's responsive nuclear deterrent capability 24 hours a day, 7 days a week, and 365 days a year. Although these systems have received service life extension programs, they are aging and there are no plans to replace them before at least 2030. At that time, the B-52, Minuteman III ICBM, and Ohio class SSBN will be 65, 55 and 42 years old, respectively. Currently, the services have initiated studies to determine the next generations of

these weapons systems, but there is no policy to guide the yet-to-be determined nuclear strategy. Without adequate policy direction, the services are operating in a vacuum and are left to base their planning assumptions, weapons designs and capabilities on outdated models.

The likelihood of a large-scale nuclear war has decreased since the end of the Cold War. However, nuclear weapon proliferation has significantly increased the number of countries in the “club of nuclear nations.” Russia remains a nuclear near-peer and continues to produce new generations of advanced nuclear weapons. China has developed an increasingly sophisticated nuclear weapons capability and has an estimated 170 nuclear weapons that are able to range the U.S. An increasing number of other nations are either nuclear-capable or developing the capability. It is unlikely that nuclear weapons will disappear in the coming decades. At present, the U.S. is the only nuclear weapons state that does not have the capability to produce a new nuclear warhead. In order to counter the continued threat of nuclear armed nations, the U.S. must determine a long-term nuclear policy, an adaptive strategy, and maintain a credible nuclear deterrent as a critical component of U.S. national security.

DETERRENCE

Nuclear weapons have been a relevant part of U.S. history and strategy since the first bombs were dropped on Hiroshima and Nagasaki in 1945. Beginning with the Soviet test of an atomic bomb in 1949, nuclear weapons became critical to U.S. national defense and the basis for deterrence policy during the Cold War. Nuclear deterrence is simply the threat of using nuclear weapons to dissuade another nation from taking an action or in response to an action. In order to counter and deter aggression by the Soviet Union, the relied heavily on its nuclear weapons policy and continuously adapted these policies to adjust to the ever-changing international, political, and military environment.

MASSIVE RETALIATION

Beginning in the early 1950s, the U.S. adopted a nuclear deterrence policy that was the basis for the national security strategy. This policy authorized the use of nuclear weapons in response to nuclear or conventional aggression by the Soviet Union. The policy allowed a disproportionate response to the growing threat posed by the Soviet Union. In 1954, Secretary of State John Foster Douglas coined the term “massive retaliation” when he stated,

“We need allies and collective security. Our purpose is to make these relations more effective, less costly. This can be done by placing more reliance on deterrent power and less dependence on local defensive power... local defense will always be important. But there is no local defense which alone will contain the mighty landpower of the Communist world. Local defenses must be reinforced by the further deterrent of massive retaliatory power. A potential aggressor must know that he cannot always prescribe battle conditions that suit him.”¹

In order to provide credibility to this policy, the U.S. produced and maintained a nuclear weapons force that was capable, effective, and reliable.

In October 1959, the U.S. fielded the first operational, nuclear tipped Atlas ICBM at Vandenberg Air Force Base. This weapon complemented the nuclear-capable strategic bombers that were already in the U.S. inventory and provided the unique capability of striking the Soviet Union from the continental U.S. and with little advanced warning to the enemy. The development and deployment of the ICBMs was in direct response to a successful test flight of the first Soviet ICBM in 1957 and the subsequent launch of the first man-made satellite, Sputnik, a few weeks later. With the successful launch of a Soviet ICBM, the nuclear arms race had begun and a surprised U.S. perceived itself as lagging behind and vulnerable to preemptive Soviet strike.² This perception, although later determined to be incorrect, led to concerns about the "missile gap," in which Central Intelligence Agency and Air Force intelligence estimates projected the Soviets had the capacity to manufacture and deploy significantly more ICBMs than

current U.S. capabilities could match. This “gap” exposed possible U.S. vulnerabilities and could leave the U.S. unable to respond to a Soviet strike. The nuclear arms race with the Soviet Union had begun.

FLEXIBLE RESPONSE, NUCLEAR TRIAD, AND MUTUALLY ASSURED DESTRUCTION

In 1961, President Kennedy revised the national security strategy and broadened the available U.S. military responses to include strategic, tactical and nuclear warfare in order to maintain a credible response to non-nuclear aggression and escalation. This U.S. policy became known as flexible response and expanded conventional options when a solely nuclear solution may not be appropriate.³ Flexible response added a requirement for the U.S. to maintain the ability to survive a nuclear preemptive strike by the Soviet Union, and then counter with a nuclear retaliatory strike sufficient to cripple the opposing nation’s military and critical infrastructure. President Kennedy based this new concept of survivability on the recently developed nuclear triad (consisting of long-range nuclear-capable bombers, ICBMs and nuclear ballistic missile submarines) that both countries had deployed successfully by 1961. With the ability of both sides to retaliate effectively, the concept of mutually assured destruction (MAD) was formed. MAD asserted that nuclear war was less likely now that both sides had the ability to counterstrike and ensure the near total destruction of the aggressor.⁴

PROTRACTED NUCLEAR CONFLICT

Until the early 1980s, the nuclear weapons policy remained relatively untouched. Under the Reagan administration, National Security Decision Directive (NSDD) 32 stated, “The modernization of our strategic nuclear forces...shall receive first priority. The United States will enhance its strategic nuclear deterrent by developing a capability to sustain protracted nuclear

conflict.”⁵ For the first time, the U.S. was not only required to maintain the ability to retaliate, but must also be prepared to fight a protracted war. In 1983, NSDD-75 stated that the Soviet Union must view war with the U.S. with “outcomes so unfavorable to the Union of Soviet Socialist Republics that there would be no incentive for Soviet leaders to initiate an attack.”⁶ To many observers, this policy seemed to shift away from deterrence strategy and reorient towards an offensive policy directing the U.S. to build the capacity to prevail in a nuclear conflict rather than maintain equilibrium amongst the two nations.

Ironically, President Reagan publicly expressed his goal of abolishing nuclear weapons. During a speech he described the concept of MAD by saying,

“The old discredited policy of MAD is like two adversaries holding loaded guns to each other’s head. It may work for a while, but you sure better hope you don’t make a slip. People who put their trust in MAD must trust it to work 100 percent – forever, no slip-ups, no madmen, no unmanageable crises, no mistakes-forever... For those who are not assured by such a prospect, and I count myself among their number, we must ask: Isn’t it time we invented a cure for the madness? Isn’t it time to begin curing the world of this nuclear threat?”⁷

In 1987, President Reagan made the initial step towards his goal of abolishing nuclear weapons when he negotiated with the Soviet Union to sign the Intermediate-Range Nuclear Forces (INF) Treaty, which eliminated nuclear ground-launched ballistic and cruise missiles with ranges between 300 and 3,400 miles. This treaty was the first ratified agreement that would actually eliminate nuclear weapons. The previous Strategic Arms Limitation Treaty (SALT) I signed in 1969 merely froze the number of nuclear weapons at current levels and placed restrictions on anti-ballistic missile systems. With this treaty, the U.S. and Soviet Union had taken the first tangible steps towards reducing the nuclear stockpiles.

“HIGH WATER” MARK OF THE U.S. NUCLEAR ARSENAL

The 1980s were the height of the U.S. nuclear force and produced some of the most advanced nuclear weapons platforms and warheads. From the Cuban Missile Crisis until the 1980s, the U.S. nuclear enterprise continued to innovate and transform the nuclear triad while maintaining an increasingly robust capability. New generations of these weapons produced technological innovations such as the multiple independently targeted reentry vehicle (MIRV—one missile capable of delivering multiple nuclear weapons to separate targets), stealth aircraft capable of penetrating enemy integrated radar and air defense systems, and submarines capable of remaining at sea for months while maintaining a high survivability rate and low probability of detection. These state-of-the-art weapon systems enabled U.S. policy to adapt to the changing threat and provided a counter to the Soviet Union’s larger conventional forces. The robust U.S. nuclear umbrella provided protection to our European allies and bolstered U.S. diplomatic standing with our partners while maintaining a credible military response to Soviet aggression.

1989 was the high water mark of the U.S. nuclear weapons enterprise. Beginning in 1981, the U.S. Navy operationally deployed the Ohio class ballistic missile submarine capable of carrying 24 Trident II submarine launched ballistic missiles. Each Trident II missile was allowed, by treaty, to carry four W-88 warheads, the most advanced warhead in the U.S. nuclear arsenal.⁸ The latest version of the U.S. ICBM, the Peacekeeper missile (formerly the missile experimental [MX]), was fielded in 1988 with the new W-87 warhead.⁹ This weapon system could deliver up to 10 MIRVs per missile and contained advanced technologies beyond the Minuteman III design and capability. Finally, the Air Force produced the F-117 stealth fighter and the B-2 stealth bomber, although these aircraft would not be seen by the public until several years later. Both aircraft were capable of penetrating enemy air defenses without detection and

deploying a variety of nuclear payloads. The high water mark of the U.S. nuclear force had been achieved, but rapid, world changing events were on the horizon and would radically alter the nature of the U.S. nuclear weapons program.

POST-COLD WAR ERA

By the mid-1980s, the economy of the Soviet Union was straining under the burden of the war in Afghanistan and the nuclear and conventional arms race with the United States. In July of 1991, the U.S. and the Soviet Union signed the Strategic Arms Reduction Treaty (START), which limited both countries to no more than 1,600 strategic delivery platforms and 6,000 accountable warheads, and was subject to a seven year drawdown period. By December of 1991, Russia, Belarus and Ukraine voted to dissolve the Soviet Union and freed the remaining republics under Soviet control.¹⁰ The former Soviet Union maintained a formidable nuclear force, but it was now clear they no longer posed an overwhelming threat to the United States. The Cold War ended in 1991 with the dissolution of the Soviet Union. The U.S. immediately shifted its focus to the peace dividend and nuclear weapons reductions. These events inadvertently facilitated the decline of the nuclear weapons enterprise.

OVERWHELMING CONVENTIONAL FORCES

At nearly the same time, a new threat emerged in place of the Soviet Union and this threat would preoccupy the U.S. for the next 12 years. The U.S. deployed alongside a United Nations coalition force to defend Saudi Arabia and forcibly remove Iraq from Kuwait. From August 1990 to February of 1991, the U.S. displayed an overwhelming military capability during DESERT SHIELD and DESERT STORM. During this time, the U.S. military efficiently and effectively utilized its advanced conventional weaponry and precision, effects-based warfare with devastating results. Within the span of a few months, U.S. and coalition forces

overwhelmed Iraq's large mechanized and ground forces and forcibly ejected them from Kuwait. For 37 days, U.S. and allied aircraft conducted precision tactical and strategic strikes on numerous Iraqi targets with very few losses and minimal resistance. Video from the precision guided strikes filled the news coverage and press conferences as the success of the campaign was visible for the world to see. The U.S. had proven its overwhelming conventional wartime capability in convincing fashion and had done it on the world stage.

“CASHING IN” ON THE PEACE DIVIDEND

In the span of only a few months, the Soviet Union had dissolved, the Cold War had ended, and the U.S. had proven its military dominance in a large-scale conventional conflict. It stood as the lone superpower with no near-peer nuclear or conventional competitors. Given these factors, President Bush made the unilateral move to de-alert SAC ICBMs and bombers throughout the Department of Defense in September 1991. This action set the conditions for the Soviet Union, and later Russia, to also de-alert its nuclear assets in the midst of its looming economic and political collapse. Additionally, President Bush ordered the deactivation and retirement of the obsolete Minuteman II ICBMs. The President called for all 450 missiles to be rendered safe and off nuclear alert within 72 hours.¹¹ This was a show of good faith in accordance with the START treaty and allowed the DoD to shed the increasing costs associated with maintaining the aged missile system. To capitalize on the peace dividend, the DoD began a sweeping reorganization and drawdown of U.S. forces. The U.S. was now focused on the conventional threats it envisioned would dominate future conflicts.

COMPREHENSIVE TEST-BAN-TREATY

In 1992, President Bush enacted a moratorium against all nuclear weapon explosive testing and signed the Comprehensive [Nuclear] Test-Ban-Treaty (CTBT). The U.S. and Russia

agreed to ban nuclear explosions in all environments, for military or civilian purposes. The treaty was deemed possible at the time since the “present international situation provided an opportunity to take further effective measures towards nuclear disarmament.”¹² Despite presidential support, Congress never ratified the CTBT due to concerns over the viability of the nuclear stockpile without functional testing. Additionally, Congress expressed concerns over the sustainment of nuclear laboratory facilities, the recruitment and long-term employment of top scientists and mandated that the U.S. must retain the right to withdraw from the treaty if the safety and reliability of a nuclear weapon cannot be certified by the Secretaries of Defense and Energy.¹³ The last attempt to ratify the treaty was rejected in 1999 and these concerns remain unaddressed.

DOD AND USAF NUCLEAR REALIGNMENT

On June 1, 1992, the Strategic Air Command stood down as the Air Force’s nuclear command and U.S. Strategic Command (USSTRATCOM) was created and designated a unified command. This reorganization immediately affected two-thirds of the DoD nuclear capability.

“STRATCOM’s mission is to deter a major military attack on the United States and its allies, and should deterrence fail, employ strategic forces. Their command goals are to: (a) establish USSTRATCOM as the leading authority on strategic matters, (b) develop capabilities and posture forces to meet strategic objectives, (c) develop force employment plans and STRATCOM’s role in defense planning and system, (d) effectively employ assigned forces in strategic operations, and (e) maintain strong, cooperative relationships with other CINC’s services and agencies.”¹⁴

STRATCOM was to be the command link between national strategy and all U.S. nuclear forces and intended to reduce the duplication of effort between the services while providing guidance and policy to the nuclear community at large.¹⁵

In the largest organizational change since the creation of the Air Force, ICBMs and nuclear-capable bombers were reassigned to the newly formed Air Combat Command (ACC).

This reorganization reduced the number of headquarters elements and flattened the organization structure. In the budget-constrained early 1990s, the Air Force had limited resources and began to focus on tactical warfare. “The likelihood of a large-scale nuclear conflict seemed far more remote, but U.S. military forces would increasingly be called upon to participate in smaller-scale regional contingencies and humanitarian operations.”¹⁶ In November 1992, the Air Force transferred the responsibility for ICBMs to Air Force Space Command, which left no single commander responsible for entire nuclear program. Nuclear-capable bombers retained their nuclear capability, but increasingly found themselves in conventional roles. For the next 14 years, the nuclear enterprise within the Air Force was deemphasized and largely forgotten.

LEAD, BUT HEDGE AND A NEW TRIAD

In 1997, the Clinton administration adopted the nuclear strategy of lead, but hedge. This strategy was the first significant departure from the former Reagan policies and called for the U.S. to lead in the reduction of deployed nuclear weapons, but hedge against threats through a robust weapons stockpile.¹⁷ The U.S. reduced the number of deployed weapons while retaining the capability to respond to unforeseen or future threats. President Clinton determined that the previous Reagan strategy maintained an overtly offensive nature when the international climate no longer required such a massive nuclear response to a less threatening Russian state. By 1997, the nuclear weapons budget had disproportionately declined by more than 71 percent from 1991 levels while conventional military forces faced only a 30 percent reduction.¹⁸

In 2002, President Bush made the first major revision to the nuclear deterrence strategy since the Cold War. Acknowledging that the U.S. faced a growing threat of dispersed, global terrorist networks, the new approach required the military to adopt an unconventional and indirect approach.¹⁹ The nation could no longer focus on the strategic threat of the former Soviet

Union, but must adapt its strategies to focus on organizations rather than nation states. In order to face the evolving threat, the DoD must move away from a threat-based approach and adopt a capabilities-based approach that allowed a flexible response to the situation.

The new triad consists of three components. The segments include:

1. SLBMs, ICBMs and Bombers (traditional triad),
2. Active and passive defenses; and,
3. Responsive and revitalized defensive infrastructure.²⁰

The new triad was formed to decrease our dependence on nuclear weapons while increasing their capability and deterrence factor in the face of WMD proliferation and terrorism. The traditional triad would remain the same, although the numbers would be reduced to the stated goal of 1,700 to 2,100 operationally deployed weapons. The stated future goal of the policy was to reduce the number of weapons to the lowest number possible while maintaining a credible deterrence.

Active and passive defenses (missile and air defense as well as increasing the survivability of the nuclear infrastructure) were intended to increase the survivability of the weapons, therefore guaranteeing a retaliatory capability. The responsive and revitalized infrastructure would enable industry to provide timely production of new systems to counter emerging threats. The final leg also integrated cyber and non-kinetic operations to the triad in order to diversify the range of options available to the U.S.²¹ While this strategy seemed to fit the international climate, no significant fiscal resources or leadership support were provided to bolster the nuclear weapons enterprise.

In 2004, President Bush's budget request to Congress included the first significant funding increase for the nuclear weapons enterprise in 15 years. This budget request included a replacement warhead design and a modernization program for the nuclear weapons complex. The Reliable Replacement Warhead (RRW) program was introduced by the National Nuclear

Security Administration to replace the aging deployed designs within the ICBM and SLBM communities. The new warhead's simple and proven weapon design did not require actual nuclear-yield testing and offered an effective alternative to the limitations of the CTBT while incorporating additional safety features. Additionally, the request included significant provisions for the upgrade, sustainment, and consolidation of the nuclear weapons complex.²² While the plans and budgetary details remain largely classified, the funding request was denied the request and failed to provide any significant funding. Congress stated that the administration failed to provide a rigorous analysis of the current situation and merely applied a smaller Cold War structure that failed to fit the current environment. The chairman of the House Appropriations energy and water subcommittee claimed the proposal was a "vacuum in administration thinking. There was no new strategy behind it. There was no plan for what the weapons were to be used for, how many there were to be, or how they were to be made."²³ RRW was abandoned in 2008 and the nuclear complex received only sustainment funding.

THE CURRENT NUCLEAR WEAPONS ENTERPRISE

The end of the Cold War provided a unique opportunity to reduce the nuclear stockpiles and recalibrate the U.S. nuclear enterprise. While the U.S. has successfully reduced the number of deployed warheads to meet the changing international climate, a long-term policy and viable defense strategy have largely remained afterthoughts. Attempts have been made to address these issues, but have not produced meaningful changes that meet current and future requirements. For the past 21 years, the government and DoD have failed to provide the sufficient resourcing and oversight to sustain and properly modernize the nuclear enterprise. The DoD has funded service life extension programs for the current arsenal of weapons and delivery platforms, but the

government has failed to adopt legislation and provide funding to create an arsenal and military force that meets the current international environment.

AIR FORCE NUCLEAR INCIDENTS

On August 31, 2007, the nuclear mission was catapulted into the spotlight when a U.S. Air Force B-52 aircraft took off from Minot Air Force Base (AFB), North Dakota with a mistaken payload of six nuclear weapons. The mission was intended to move conventionally armed Advanced Cruise Missiles (ACM) to Barksdale AFB to facilitate their demilitarization and remove the ACMs from the active weapons inventory.²⁴ After arrival at Barksdale, the aircraft was left unattended for nine hours until the nuclear weapons were discovered and secured by the ground crew. While safety and security are the cornerstones of U.S. policy towards nuclear weapons, the Air Force had allowed six weapons to be removed from the controlled stockpile, inadvertently and unknowingly transported across the country, and left unsecured on a minimally guarded airfield.

On March 28, 2008, another nuclear mistake was discovered when then Air Force Secretary Michael Wynn announced that the Air Force had mistakenly shipped Taiwan four timing fuses for a MK-12 nuclear warhead. Taiwan had requested to purchase helicopter batteries but instead received the sensitive, non-nuclear components as the result of a clerical supply error. The shipment occurred in June 2006 and the error was reported by Taiwan in January 2007, but the Air Force failed to launch an investigation until March 2008. This sensitivity of the situation was magnified due to U.S. and China relations regarding Taiwan and required President Bush to telephone Chinese President Hu Jintao “to assure him that the transfer was inadvertent and did not represent a shift in U.S. policy towards Taiwan.”²⁵ Ryan Henry, Principal Deputy Under Secretary of Defense for Policy, called the mistake “disconcerting and

intolerable.”²⁶ In slightly over six months, the Air Force faced a second incident involving their nuclear community.

In both of the nuclear incidents, the Air Force failed to grasp the severity of the situation and initially explained the incidents were localized failures and unlikely to be repeated. Before the results of the investigations were complete, there were already signs that Air Force leaders failed to accept responsibility, did not recognize the severity of the problem, and underestimated the level scrutiny these events would generate. This indicates a decline in the understanding and perceived importance of the nuclear mission by Air Force leadership. During the B-52 incident, the Air Force declined to make a public statement about the mishap, in part because of policies that prohibit the confirmation of any details about the storage or movement of nuclear weapons. Air Force senior leadership assessed interest in the incident as “No press interest anticipated.”²⁷

ROOT CAUSE OF FAILURES

In response to the incidents, the Chief of Staff of the Air Force (CSAF) formed a Blue Ribbon Review Panel in 2007 to review the current nuclear weapons policies and procedures.²⁸ The report was released in February of 2008 and concluded that “the USAF has a sound nuclear surety program”, but the “team observed areas needing enhancement.”²⁹ That same month, Lieutenant General Darnell, Deputy Chief of Staff, Headquarters Air Force Plans and Operations, testified before the U.S. Senate Committee on Armed Services that “The root causes identified for the specific incident [Minot] were unit level leadership and discipline breakdown among a small group of airmen at Barksdale Air Force Base and Minot Air Force Base.”³⁰

Secretary Gates was unconvinced and lost confidence in the Air Force’s ability to conduct a candid self-assessment and determine the root cause of the issue. After the release of the Air Force report, Secretary Gates authorized Admiral Donald, the senior military commander

with nuclear responsibilities within the Department of Defense, to conduct an independent investigation that would confirm the details of the Air Force report, while providing an independent assessment and list of recommendations. The report was delivered on June 5th and Secretary Gates summarized the report by concluding,

A degradation of the authority, standards of excellence and technical competence within the nation's ICBM force. Similar to the bomber-specific August 2007 Minot-Barksdale nuclear weapons transfer incident, this incident took place within the larger environment of declining Air Force nuclear mission focus and performance" and that "the investigation identified commonalities between the August 2007 Minot incident and this [the Taiwan] event." In his investigation report, Donald stated that the issues identified by his investigation were, "Indicative of an overall decline in Air Force nuclear weapons stewardship, a problem that has been identified but not effectively addressed for over a decade. Both the Minot-Barksdale nuclear weapons transfer incident and the Taiwan misshipment; while different in specifics, have a common origin: the gradual erosion of nuclear standards and a lack of effective oversight by Air Force leadership."³¹

Based on the findings of Admiral Donald, the Secretary of Defense Gates summoned Secretary of the Air Force Michael Wynn and CSAF General Mosely to the Pentagon and asked for their resignation.

Secretary Gates made immediate changes and mandated the Air Force refocus and reprioritize the nuclear mission while implementing measures of accountability. He then convened an independent task force chaired by the Honorable James Schlesinger, a former Secretary of Defense, Secretary of Energy, and Director of Central Intelligence. The task force was to provide an independent assessment and recommendations for the Air Force nuclear mission and a follow-on report to assess the DoD. The initial report was published in September of 2008 and the most important assessment was "there has been an unambiguous, dramatic, and unacceptable decline in the Air Force's commitment to perform the nuclear missions and, until very recently, little has been done to reverse it."³²

CRITICAL ASSESSMENT OF DOD NUCLEAR PROGRAMS

The SecDef Nuclear Task Force determined there were 6 recurring themes that led to the degradation of the nuclear mission.

1. Underinvestment in the nuclear deterrence mission is evident – little advocacy for sustainment;
2. Nuclear authority and responsibility is fragmented;
3. Nuclear inspection process is ineffective at determine systemic problems;
4. Nuclear expertise has eroded;
5. Self-assessment and accountability culture are lacking; and
6. Nuclear culture has diminished.³³

The report found that a lack of leadership, advocacy and nuclear expertise at the senior levels were the root causes. The fragmented organizational structure and focus on conventional operations after 1991 led to an erosion of nuclear standards and leadership. Organizationally, the task force concluded that no single senior Air Force officer “owns” the nuclear mission and numerous nuclear equities are spread across two major commands and multiple supporting agencies. Sustainment processes were found to lack adequate inventory validity and procedural compliance.³⁴ The report concluded there was a systematic failure within the Air Force nuclear enterprise that would require executive-level leadership involvement, major reorganization and a long term commitment to deliberately managing the development and culture of the nuclear force. Additionally, several previous reports noted the Air Force has been aware of these problems for over ten years, but failed to correct them.

Phase II of the SecDef Task Force was an assessment of the entire DoD community. The report found that the “lack of interest in and attention to the nuclear mission and nuclear deterrence...go well beyond the Air Force. This lack of interest and attention have been widespread throughout the DoD and contributed to the decline of attention in the Air Force.”³⁵ The report covered all aspects of the nuclear community within DoD, to include the Joint Staff,

USSTRATCOM, and the geographic combatant commands. It found that USSTRATCOM suffered from mission proliferation, reduced personnel and a lack of nuclear expertise. These problems were common across the combatant commands, but the nuclear mission was disproportionately affected as the military shifted away from the nuclear forces. The Schlesinger Task Force determined that USSTRATCOM was unable to effectively accomplish the nuclear mission it was charged with in 1992. Throughout DoD, the task force discovered the same fragmentation among all nuclear functions and a clear lack of emphasis. Senior leaders within DoD lacked the oversight, commitment to sustainment and focus on nuclear policy that were systemic of the incidents within the Air Force. Deterrence appeared to be nothing more than an outdated, discarded theory and the nuclear mission of the military no longer fit into DoD's current focus on irregular warfare.³⁶

The Schlesinger Task Force argued that a credible nuclear deterrence required nuclear policy be articulated by the White House. Without the support of the President, the primary mission of nuclear deterrence would fail. The Schlesinger Task Force contends that nuclear weapons are unique and cannot be treated as other military weapons.³⁷ "Because nuclear weapons have been less prominent since the end of the Cold War and have not been used since World War II, their importance and unique role as a deterrent have been obscured though not diminished."³⁸ The intent of a nuclear weapon is to set the conditions so that it never needs to be used. It cannot be seen like an aircraft carrier off the coast of a hostile country nor can the nation threaten its use unless we desire to extend our most powerful threat and military action.

In 2009, President Obama set the tone for his nuclear policy during a head of state visit to Prague. He said the U.S. will "seek the peace and security of a world without nuclear weapons."³⁹ He acknowledged that this event may not be achieved in our lifetime, he committed

to reduce the number of U.S. nuclear weapons and to minimize their role within the U.S. national security strategy. Despite his policy to reduce the number and reliance upon nuclear weapons, he asserted that as long as nuclear weapons existed, “the United States will maintain a safe, secure and effective arsenal to deter any adversary, and guarantee that defense to our allies – including the Czech Republic. But we will begin the work of reducing our arsenal.”⁴⁰

RECOMMENDATIONS FOR THE WAY AHEAD

The nuclear weapons enterprise must be recalibrated to match the current international environment. In order to do this, the U.S. government must clearly articulate a long-term policy and strategy and provide the resources to achieve the stated goal. The nuclear enterprise must be appropriately sized and modernized, while reconstituting the personnel expertise and infrastructure required to support the weapons. Direction and priority must be articulated by the senior levels of government and be led by the White House and congress.

Since the INF Treaty in 1987, the U.S. has actively pursued a reduction of the nuclear weapons stockpile through a series of patchwork treaties and unilateral actions. These actions have been taken with no discernible long-term strategy that is approved and appear to be based solely on the Russian nuclear capability and their willingness to reciprocate. Despite Russia’s capable arsenal, the U.S. government must review the current international environment and what type of nuclear enterprise best addresses the threat while articulating a long-term plan that retains the flexibility to deter future adversaries. U.S. nuclear weapons have no deterrent value against a terrorist organization and they are equally ineffective against a nation determined to develop or share nuclear weapons technology. Nuclear weapons are not a solution to every security threat and must be appropriately focused on the correct type of threats.

The 2010 Nuclear Posture Review mentions a vague, narrow range of contingencies in which the U.S. may use nuclear weapons in response to a conventional, or chemical and biological weapon threat against the U.S. or its allies. While this strategy appears to be more in line with the current threat and international environment, it fails to provide any meaningful guidance for the nuclear community or our adversaries. This lack of policy and clear long-term strategy marginalizes and deemphasizes the role of nuclear weapons throughout DoD. The Schlesinger Task Force reports indicate this lack of a clear policy is a direct contributing factor to the decline in the nuclear community and can be attributed to the Air Force incidents.

At present, the U.S. is the only nuclear weapons state that does not have the capability to produce a new nuclear warhead.⁴¹ The capability of the U.S. nuclear enterprise has not improved significantly over the last 20 years despite weapons advancements made by Russia and China. The current generation of nuclear warheads is unlikely to outlast the continued need for nuclear weapons. A new generation of weapon, the Reliable Replacement Warhead, was recently canceled, and there are no plans to seek new weapons. Due to the CTBT, the U.S. cannot conduct any testing on nuclear weapons and must rely on computer modeling. While this may provide sufficient confidence in the current nuclear stockpile, there is no strategy for addressing a major failure in the current inventory that could require actual testing and no plan to produce a new warhead. A new weapon design must be explored if U.S. nuclear weapons are to remain credible and viable beyond 2030.

The U.S. must recapitalize the DoD nuclear enterprise. The current workhorses of the nuclear triad consist of MMIII missiles built in 1970, B-52H bombers built in 1952 and Ohio-class submarines built in 1982. These delivery platforms have received service life extension programs and are scheduled to remain in service until at least 2030.⁴² When the youngest of

these weapon systems retires, it will be 42 years old. DoD is currently reviewing the next generation solutions for these platforms, but it faces a fiscal reality that may not allow for like-kind replacements. A long-term strategy is required to determine if the U.S. will continue to employ a triad capability or reduce the type and variety of nuclear forces.

The DoE faces an aging infrastructure, difficulty recruiting top talent, and a nuclear weapons mission that is politically unpopular. Cold War facilities continue to operate at a reduced capacity and are in need of upgrade or consolidation. Budgetary dollars allocated for the DoE must be dispersed among the nuclear weapons enterprise, nuclear counter-proliferation programs and energy programs. The nuclear weapons enterprise lacks the advocacy needed to maintain a highly capable weapons enterprise. Due to the CTBT and the political refusal to create new weapons designs, DoE has difficulty in recruiting top talent to fill weapons programs. Much of the knowledge learned over the decades during nuclear weapons testing has deteriorated and would require an extensive amount of time to develop if the U.S. is to design a nuclear weapon. This lack of experience becomes especially problematic if development of a new weapon is time constrained and based upon an emerging threat.

The current nuclear policy states “the United States will maintain a safe, secure and effective arsenal to deter any adversary, and guarantee that defense to our allies.”⁴³ In order remain credible with our allies and our enemies, the U.S. nuclear enterprise cannot decline while other powers (Russia, China, North Korea, Iran, etc.) modernize. If the U.S. is to reduce its nuclear weapons significantly and without equal concessions from the Russians, then the quantity of nuclear weapons is less important than the quality of the weapons. Policy must then articulate the U.S. maintains the commitment to using nuclear weapons when a stated threshold is met.

CONCLUSION

The current threat to the U.S. is vastly different than the threat faced during the Cold War. While today's dynamic international climate requires less dependence on nuclear weapons, they remain critical to national security so long as they are also possessed by another nation. Gen Chilton, former STRATCOM Commander, stated "Although the strategic landscape has dramatically shifted since the end of the Cold War, the concept of deterrence and the need to deter adversaries from attacking our vital interests is just as important in the 21st century as it was in the last century."⁴⁴ A long-term nuclear policy must not only emphasize the U.S. desire to reduce the number of weapons, but also provide meaningful guidance that they are critical to U.S. national security and not just a Cold War relic within the military strategy. As the U.S. reduces its nuclear forces, a highly-capable enterprise must be available to provide national security.

What will the U.S. nuclear enterprise look like in 20 years if we do nothing? Today's nuclear capability and policy does not match the climate in which we operate and requires a different approach from the Cold War. Today's climate demands a very narrow range in which nuclear weapons may be contemplated, but while this segment of national defense is extremely limited, it cannot be ignored. The U.S. must send a clear message that nuclear deterrence matters and is an active component of national defense that receives sufficient policy, planning and resourcing. Nuclear counter-proliferation has largely failed and the number of nations that have or are attempting to acquire nuclear weapons is undeterred by current U.S. and international efforts. In an increasingly complex world, the U.S. must continue to reduce the number of weapons while providing a nuclear umbrella to our allies and partners. To reassure our allies, partners and enemies, the U.S. must modernize the enterprise in order to maintain a capable and

credible force for the future. It is impossible to determine what threats the U.S. will face over the next 20 years, but it is unlikely the world will be free of nuclear weapons.

APPENDIX A – Acronyms

ACC – Air Combat Command

ACM – Advanced cruise missile

CSAF – Chief of Staff of the Air Force

CTBT – Comprehensive Nuclear Test-Ban-Treaty

DoD – Department of Defense

DoE – Department of Energy

ICBM – Intercontinental Ballistic Missile

INF – Intermediate-range Nuclear Forces

MAD – Mutually Assured Destruction

MIRV – Multiple Independently Targetable Reentry Vehicle

MX – Missile Experimental

NSDD – National Security Decision Directive

RRW – Reliable Replacement Warhead

SAC – Strategic Air Command

SALT – Strategic Arms Limitation Treaty

SecDef – Secretary of Defense

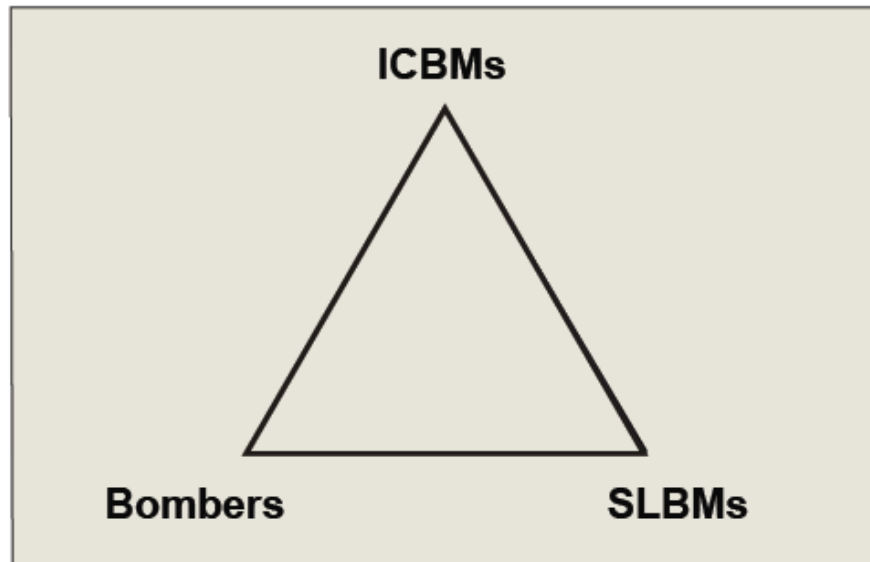
SLBM – Submarine Launched Ballistic Missile

USSR – Union of Soviet Socialist Republics

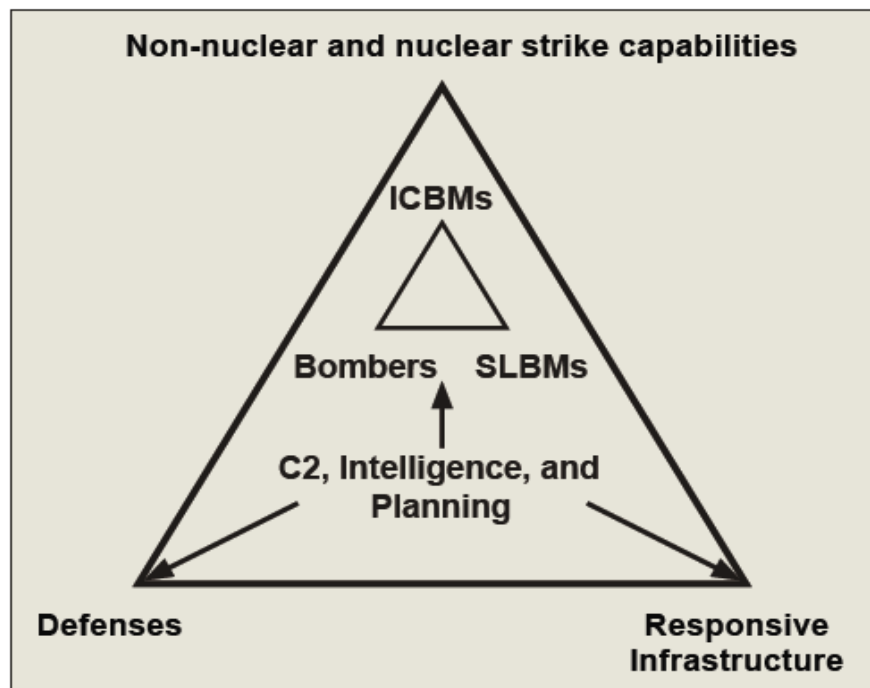
USSTRATCOM – United States Strategic Command

WMD – Weapons of mass destruction

APPENDIX B – Illustration of the Nuclear Triads



Traditional Nuclear Triad 1962 - 2002



Enhanced Conventional and Nuclear Triad

Source:

Johns Hopkins University Applied Physics Laboratory Report; THE NEW TRIAD: Diffusion, Illusion, and Confusion in the Nuclear Mission

<http://www.jhuapl.edu/ourwork/nsa/triad/TheNewTriad.pdf>, accessed April 4, 2012.

APPENDIX C – Illustration and Specifications Fleet Ballistic Missile Submarines - SSBN U.S. Navy Fact Sheet

Description

Since the 1960s, strategic deterrence has been the SSBN's sole mission, providing the United States with its most survivable and enduring nuclear strike capability.

Features

The Navy's fleet ballistic missile submarines, often referred to as "Boomers," serve as an undetectable launch platform for intercontinental missiles. They are designed specifically for stealth and the precision delivery of nuclear warheads.

Ohio class SSBNs can carry up to 24 submarine-launched ballistic missiles (SLBMs) with multiple independently-targeted warheads. The SSBN's strategic weapon is the Trident II D5 missile, which provides increased range and accuracy over the now out-of-service Trident I C4 missile.



SSBNs are specifically designed for extended deterrent patrols. To increase the amount of time required for replenishment and maintenance, *Ohio* class submarines have three large-diameter logistics hatches that allow sailors to rapidly transfer supply pallets, equipment replacement modules and machinery components thereby increasing their operational availability.

The *Ohio* class design allows the submarines to operate for 15 or more years between major overhauls. On average, the submarines spend 77 days at sea followed by 35 days in-port for maintenance. Each SSBN has two crews, Blue and Gold, which alternate manning the submarines while on patrol. This maximizes the SSBN's strategic availability, reduces the number of submarines required to meet strategic requirements and allows for proper crew training, readiness, and morale.

General Characteristics, *Ohio* Class

Builder: General Dynamics Electric Boat Division.

Date Deployed: Nov. 11, 1981 (USS *Ohio*)

Propulsion: One nuclear reactor, one shaft.

Length: 560 feet (170.69 meters).

Beam: 42 feet (12.8 meters).

Displacement: 16,764 tons (17,033.03 metric tons) surfaced; 18,750 tons (19,000.1 metric tons) submerged.

Speed: 20+ knots (23+ miles per hour, 36.8+ kph).

Crew: 15 Officers, 140 Enlisted.

Armament: 24 tubes for Trident II submarine-launched ballistic missiles, MK48 torpedoes, four torpedo tubes.

Ships:

USS Henry M. Jackson (SSBN 730), Bangor, WA
USS Alabama (SSBN 731), Bangor, WA
USS Alaska (SSBN 732), Kings Bay, GA
USS Nevada (SSBN 733), Bangor, WA
USS Tennessee (SSBN 734), Kings Bay, GA
USS Pennsylvania (SSBN 735), Bangor, WA
USS West Virginia (SSBN 736), Portsmouth, VA
USS Kentucky (SSBN 737), Bangor, WA
USS Maryland (SSBN 738), Kings Bay, GA
USS Nebraska (SSBN 739), Bangor, WA
USS Rhode Island (SSBN 740), Kings Bay, GA
USS Maine (SSBN 741), Bangor, WA
USS Wyoming (SSBN 742), Kings Bay, GA
USS Louisiana (SSBN 743), Bangor, WA

Source:

U.S. Navy Fact File Website:

http://www.navy.mil/navydata/fact_display.asp?cid=4100&tid=200&ct=4, accessed April 4, 2012

APPENDIX D – Illustrations and Specifications B-2 SPIRIT

Mission

The B-2 Spirit is a multi-role bomber capable of delivering both conventional and nuclear munitions. A dramatic leap forward in technology, the bomber represents a major milestone in the U.S. bomber modernization program. The B-2 brings massive firepower to bear, in a short time, anywhere on the globe through previously impenetrable defenses.



Features

Along with the B-52, the B-2 provides the penetrating flexibility and effectiveness inherent in manned bombers. Its low-observable, or "stealth," characteristics give it the unique ability to penetrate an enemy's most sophisticated defenses and threaten its most valued, and heavily defended, targets. Its capability to penetrate air defenses and threaten effective retaliation provides a strong, effective deterrent and combat force well into the 21st century.

The revolutionary blending of low-observable technologies with high aerodynamic efficiency and large payload gives the B-2 important advantages over existing bombers. Its low-observability provides it greater freedom of action at high altitudes, thus increasing its range and a better field of view for the aircraft's sensors. Its unrefueled range is approximately 6,000 nautical miles (9,600 kilometers).

The B-2's low observability is derived from a combination of reduced infrared, acoustic, electromagnetic, visual and radar signatures. These signatures make it difficult for the sophisticated defensive systems to detect, track and engage the B-2. Many aspects of the low-observability process remain classified; however, the B-2's composite materials, special coatings and flying-wing design all contribute to its "stealthiness."

The B-2 has a crew of two pilots, a pilot in the left seat and mission commander in the right, compared to the B-1B's crew of four and the B-52's crew of five.

Background

The first B-2 was publicly displayed on Nov. 22, 1988, when it was rolled out of its hangar at Air Force Plant 42, Palmdale, Calif. Its first flight was July 17, 1989. The B-2 Combined Test Force, Air Force Flight Test Center, Edwards Air Force Base, Calif., is responsible for flight testing the engineering, manufacturing and development aircraft on the B-2.

Whiteman AFB, Mo., is the only operational base for the B-2. The first aircraft, Spirit of Missouri, was delivered Dec. 17, 1993. Depot maintenance responsibility for the B-2 is performed by Air Force contractor support and is managed at the Oklahoma City Air Logistics Center at Tinker AFB, Okla.

The combat effectiveness of the B-2 was proved in Operation Allied Force, where it was responsible for destroying 33 percent of all Serbian targets in the first eight weeks, by flying nonstop to Kosovo from its home base in Missouri and back. In support of Operation Enduring Freedom, the B-2 flew one of its longest missions to date from Whiteman to Afghanistan and back. The B-2 completed its first-ever combat deployment in support of Operation Iraqi Freedom, flying 22 sorties from a forward operating location as well as 27 sorties from Whiteman AFB and releasing more than 1.5 million pounds of munitions. The aircraft received full operational capability status in December 2003. On Feb. 1, 2009, the Air Force's newest command, Air Force Global Strike Command, assumed responsibility for the B-2 from Air Combat Command.

The prime contractor, responsible for overall system design and integration, is Northrop Grumman Integrated Systems Sector. Boeing Military Airplanes Co., Hughes Radar Systems Group, General Electric Aircraft Engine Group and Vought Aircraft Industries, Inc., are key members of the aircraft contractor team.

General Characteristics

Primary function: Multi-role heavy bomber

Contractor: Northrop Grumman Corp. and **Contractor Team:** Boeing Military Airplanes Co., Hughes Radar Systems Group, General Electric Aircraft Engine Group and Vought Aircraft Industries, Inc.

Power Plant: Four General Electric F118-GE-100 engines

Thrust: 17,300 pounds each engine

Wingspan: 172 feet (52.12 meters)

Length: 69 feet (20.9 meters)

Height: 17 feet (5.1 meters)

Weight: 160,000 pounds (72,575 kilograms)

Maximum Takeoff Weight: 336,500 pounds (152,634 kilograms)

Fuel Capacity: 167,000 pounds (75,750 kilograms)

Payload: 40,000 pounds (18,144 kilograms)

Speed: High subsonic

Range: Intercontinental

Ceiling: 50,000 feet (15,240 meters)

Armament: Conventional or nuclear weapons

Crew: Two pilots

Unit cost: Approximately \$1.157 billion (fiscal 98 constant dollars)

Initial operating capability: April 1997

Inventory: Active force: 20 (1 test); ANG: 0; Reserve: 0

Source:

U.S. Air Force Fact File website: <http://www.af.mil/information/factsheets/factsheet.asp?id=82>, accessed April 4, 2012

APPENDIX E – Illustrations and Specifications B-52 STRATOFORTRESS

Mission

The B-52 is a long-range, heavy bomber that can perform a variety of missions. The bomber is capable of flying at high subsonic speeds at altitudes up to 50,000 feet (15,166.6 meters). It can carry nuclear or precision guided conventional ordnance with worldwide precision navigation capability.



Features

In a conventional conflict, the B-52 can perform strategic attack, close-air support, air interdiction, offensive counter-air and maritime operations. During Desert Storm, B-52s delivered 40 percent of all the weapons dropped by coalition forces. It is highly effective when used for ocean surveillance, and can assist the U.S. Navy in anti-ship and mine-laying operations. Two B-52s, in two hours, can monitor 140,000 square miles (364,000 square kilometers) of ocean surface.

All B-52s can be equipped with two electro-optical viewing sensors, a forward-looking infrared and advanced targeting pods to augment targeting, battle assessment, and flight safety, thus further improving its combat ability.

Pilots wear night vision goggles, or NVG, to enhance their vision during night operations. Night vision goggles provide greater safety during night operations by increasing the pilot's ability to visually clear terrain, avoid enemy radar and see other aircraft in a lights-out environment.

Starting in 1989, on-going modifications incorporate the global positioning system, heavy stores adapter beams for carrying 2,000 pound munitions, and a full array of advance weapons currently under development.

The use of aerial refueling gives the B-52 a range limited only by crew endurance. It has an unrefueled combat range in excess of 8,800 miles (14,080 kilometers).

Background

For more than 40 years B-52 Stratofortresses have been the backbone of the manned strategic bomber force for the United States. The B-52 is capable of dropping or launching the widest array of weapons in the U.S. inventory. This includes gravity bombs, cluster bombs, precision guided missiles and joint direct attack munitions. Updated with modern technology the B-52 will be capable of delivering the full complement of joint developed weapons and will continue into the 21st century as an important element of our nation's defenses. Current engineering analyses show the B-52's life span to extend beyond the year 2040.

The B-52A first flew in 1954, and the B model entered service in 1955. A total of 744 B-52s were built with the last, a B-52H, delivered in October 1962. The first of 102 B-52H's was delivered to Strategic Air Command in May 1961. The H model can carry up to 20 air launched cruise missiles. In addition, it can carry the conventional cruise missile that was launched in several contingencies during the 1990s, starting with Operation Desert Storm and culminating with Operation Iraqi Freedom.

The aircraft's flexibility was evident in Operation Desert Storm and again during Operations Allied Force. B-52s struck wide-area troop concentrations, fixed installations and bunkers, and decimated the morale of Iraq's Republican Guard. On Sept. 2 to 3, 1996, two B-52H's struck Baghdad power stations and communications facilities with 13 AGM-86C conventional air launched cruise missiles, or CALCMs, as part of Operation Desert Strike. This mission was the longest distance flown for a combat mission involving a 34-hour, 16,000 statute mile round trip from Barksdale Air Force Base, La.

In 2001, the B-52 contributed to the success in Operation Enduring Freedom, providing the ability to loiter high above the battlefield and provide close air support through the use of precision guided munitions.

The B-52 also played a role in Operation Iraqi Freedom. On March 21, 2003, B-52Hs launched approximately 100 CALCMs during a night mission.

Only the H model is still in the Air Force inventory and is assigned to the 5th Bomb Wing at Minot AFB, N.D. and the 2nd Bomb Wing at Barksdale AFB, La., which fall under Air Force Global Strike Command. The aircraft is also assigned to the Air Force Reserve Command's 307th Bomb Wing at Barksdale.

General Characteristics

Primary Function: Heavy bomber

Contractor: Boeing Military Airplane Co.

Power plant: Eight Pratt & Whitney engines TF33-P-3/103 turbofan

Thrust: Each engine up to 17,000 pounds

Wingspan: 185 feet (56.4 meters)

Length: 159 feet, 4 inches (48.5 meters)

Height: 40 feet, 8 inches (12.4 meters)

Weight: Approximately 185,000 pounds (83,250 kilograms)

Maximum Takeoff Weight: 488,000 pounds (219,600 kilograms)

Fuel Capacity: 312,197 pounds (141,610 kilograms)

Payload: 70,000 pounds (31,500 kilograms)

Speed: 650 miles per hour (Mach 0.86)

Range: 8,800 miles (7,652 nautical miles)

Ceiling: 50,000 feet (15,151.5 meters)

Armament: Approximately 70,000 pounds (31,500 kilograms) mixed ordnance -- bombs, mines and missiles. (Modified to carry air-launched cruise missiles)

Crew: Five (aircraft commander, pilot, radar navigator, navigator and electronic warfare officer)

Unit Cost: \$53.4 million (fiscal 98 constant dollars)

Initial operating capability: April 1952

Inventory: Active force, 85; ANG, 0; Reserve, 9

Source:

U.S. Air Force Fact File website: <http://www.af.mil/information/factsheets/factsheet.asp?fsID=83>, accessed April 4, 2012

APPENDIX F – Illustration and Specifications LGM-30G MINUTEMAN III

Mission

The LGM-30G Minuteman intercontinental ballistic missile, or ICBM, is an element of the nation's strategic deterrent forces under the control of the Air Force Global Strike Command. The "L" in LGM is the Department of Defense designation for silo-launched; "G" means surface attack; and "M" stands for guided missile.

Features

The Minuteman is a strategic weapon system using a ballistic missile of intercontinental range. Missiles are dispersed in hardened silos to protect against attack and connected to an underground launch control center through a system of hardened cables. Launch crews, consisting of two officers, perform around-the-clock alert in the launch control center.

A variety of communication systems provide the president and secretary of defense with highly reliable, virtually instantaneous direct contact with each launch crew. Should command capability be lost between the launch control center and remote missile launch facilities, specially configured E-6B airborne launch control center aircraft automatically assume command and control of the isolated missile or missiles. Fully qualified airborne missile combat crews aboard airborne launch control center aircraft would execute the president's orders.



An extensive life extension program is underway to keep the remaining missiles safe, secure and reliable well into the 21st century. These major programs include: remanufacture of the solid-propellant rocket motors, replacement of standby power systems, repair of launch facilities, and installation of updated, survivable communications equipment and additional security enhancements.

Background

The Minuteman weapon system was conceived in the late 1950s and Minuteman I was deployed in the early 1960s. Minuteman was a revolutionary concept and an extraordinary technical achievement. Both the missile and basing components incorporated significant advances beyond the relatively slow-reacting, liquid-fueled, remotely-controlled intercontinental ballistic missiles of the previous generation. From the beginning, Minuteman missiles have provided a quick-reacting, inertially guided, highly survivable component to America's strategic deterrent program. Minuteman's maintenance concept capitalizes on high reliability and a "remove and replace" approach to achieve a near 100 percent alert rate.

Through state-of-the-art improvements, the Minuteman system has evolved to meet new challenges and assume new missions. Modernization programs have resulted in new versions of the missile, expanded targeting options, improved accuracy and survivability. Today's Minuteman weapon system is the product of almost 40 years of continuous enhancement.

The current Minuteman force consists of 450 Minuteman III's located at the 90th Missile Wing at F.E. Warren AFB, Wyo.; the 341st Missile Wing at Malmstrom AFB, Mont.; and the 91st Missile at Minot AFB, N.D.

General Characteristics

Primary Function: Intercontinental ballistic missile

Contractor: Boeing Co.

Power Plant: Three solid-propellant rocket motors; first stage - Thiokol; second stage - Aerojet-General; third stage - United Technologies Chemical Systems Division

Thrust: First stage, 202,600 pounds

Length: 59.9 feet (18 meters)

Weight: 79,432 pounds (36,030 kilograms)

Diameter: 5.5 feet (1.67 meters)

Range: 6,000-plus miles (5,218 nautical miles)

Speed: Approximately 15,000 mph (Mach 23 or 24,000 kph) at burnout

Ceiling: 700 miles (1,120 kilometers)

Date deployed: June 1970, production cessation: December 1978

Inventory: Active force, 450; Reserve, 0; ANG, 0

Source:

U.S. Air Force Fact File website: <http://www.af.mil/information/factsheets/factsheet.asp?id=113>, accessed April 4, 2011

END NOTES

¹ John Dulles. "The Evolution of Foreign Policy," Department of State Bulletin, vol. 30, January 25, 1954.

² Greg Thielman. "The Missile Gap Myth and its Progeny." Arms Control Association, May 2011, http://www.armscontrol.org/act/2011_05/Thielmann (accessed on December 27, 2011).

³ Project of the Nuclear Age Peace Foundation, "Flexible Response", <http://www.nuclearfiles.org/menu/key-issues/nuclear-weapons/history/cold-war/strategy/strategy-flexible-response.htm>.

⁴ Alan Parrington, "Mutually Assured Destruction Revisited," *Airpower Journal*, Winter 1997. <http://www.airpower.maxwell.af.mil/airchronicles/apj/apj97/win97/parrin.html> (accessed April 1, 2012).

⁵ Richard Halloran, "Protracted Nuclear War", *Air Force Magazine*, March 2008, <http://www.airforce-magazine.com/MagazineArchive/Pages/2008/March%202008/0308nuclear.aspx> (accessed March 27, 2012).

⁶ Ibid

⁷ The Reagan Vision for a Nuclear Free World, "The Reagan Vision", <http://www.thereaganvision.org/the-reagan-vision/> (accessed March 29 2012).

⁸ Harold Agnew, "Letter: Looking for Spies in Nuclear Kitchen", *Wall Street Journal*, p. A27, May 17 1999. <http://www.fas.org/irp/ops/ci/agnewwsj.html> (accessed February 26 2012).

⁹ National Museum of the Air Force, "50 Years of ICBMs." <http://www.nationalmuseum.af.mil/shared/media/document/AFD-090731-063.pdf> (accessed on December 29, 2011)

¹⁰ U.S. Department of State, *Treaty Between the United States of American and the Union of the Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms*. Washington, DC, January 20, 2001.

¹¹ U.S. Department of the Interior, *Minuteman ICBM Launch Control Facility Delta-01 and Launch Facility Delta-09, Ellsworth Air Force Base*. June 26, 2003. http://www.cr.nps.gov/history/online_books/mimi/hrsab.pdf

¹² U.S. Department of State, *The Comprehensive Nuclear Test Ban Treaty*. Washington, DC, September 10 1996. <http://www.state.gov/www/global/arms/treaties/ctbt/ctbt-preamble.html>

¹³ Jonathan Medalia, *Nuclear Weapons: Comprehensive Test Ban Treaty*, CRS Report for Congress RL34394 (Washington, DC: Congressional Research Service, March 12 2008), 50-52, <http://www.fas.org/sgp/crs/nuke/RL34394.pdf> (accessed January 12, 2012).

¹⁴ Jon Fontenot, "A New Era: SAC to STRATCOM," (Master's Thesis, Marine Corps University, 1995). <http://www.fas.org/spp/eprint/fontenot.htm> (accessed January 17, 2012).

¹⁵ Ibid

¹⁶ U.S. Air Force, Air Combat Command, *Air Combat Command History*. <http://www.acc.af.mil/library/acchistory.asp> (accessed January 4, 2012).

¹⁷ U.S. Department of Defense and U.S. Department of Energy, *National Security and Nuclear Weapons in the 21st Century*. Arlington, VA: Departments of Defense and Energy, 2008.

¹⁸ Stephen Schwartz, "On Weapons Spending" The Brookings Institute, 1998, <http://www.brookings.edu/projects/archive/nucweapons/fullnyt.aspx> (accessed April 20, 2012).

-
- ¹⁹ U.S. Department of Defense, *The Quadrennial Defense Review*. Arlington, VA: Department of Defense, February 6, 2006, 48-50. http://www.nuclearfiles.org/menu/key-issues/nuclear-weapons/history/prez_policies/bush2/QDR.pdf (accessed January 15, 2012).
(accessed
- ²⁰ U.S. Department of Defense, Office of the Deputy Assistant to the Secretary of Defense for Nuclear Matters, "US Nuclear Stockpile Management." <http://www.acq.osd.mil/ncbdp/nm/USNuclearDeterrence.html>
- ²¹ U.S. Department of Defense, Nuclear Posture Review. Arlington, VA: Department of Defense, January 9 2002, 1-3. <http://www.defense.gov/news/jan2002/d20020109npr.pdf> (accessed February 26, 2012).
- ²² Wade Boese, "Bush Seeks Budget Boost for Future Warhead", March 2007, Arms Control Association, <http://www.armscontrol.org/print/2345> (accessed April 20, 2012).
- ²³ Jeffrey Lewis, "After the Reliable Replacement Warhead: What's Next for the U.S. Arsenal," December 2008, Arms Control Association, <http://www.armscontrol.org/print/3463> (accessed April 19, 2012).
- ²⁴ Michelle Spencer and Aadin Ludin and Heather Nelson. Air University, "United States Air Force Minot and Taiwan Nuclear Weapons-Related Incidents: An Assessment" (Maxwell, AL: Air University Press, 2011), 6, <http://www.au.af.mil/au/aul/school/awc/core/6200-15-spencer-united.pdf>.
- ²⁵ Patrick Martin, "US shipped Fuses for Nuclear-Armed Missiles to Taiwan." World Socialist Web Site, <http://www.wsws.org/articles/2008/mar2008/nuke-m28.shtml> (accessed January 21, 2012).
- ²⁶ Associated Press, "US Mistakenly Ships ICBM Parts to Taiwan." Military.com, <http://www.military.com/NewsContent/0,13319,164694,00.html> (accessed 4 January, 2012)
- ²⁷ Joby Warrick and Walter Pincus, "Missteps in the bunker," *The Washington Post*, September 23, 2007. <http://www.washingtonpost.com/wp-dyn/content/article/2007/09/22/AR2007092201447.html> (accessed January 2, 2012).
- ²⁸ Michelle Spencer and Aadin Ludin and Heather Nelson. Air University, "United States Air Force Minot and Taiwan Nuclear Weapons-Related Incidents: An Assessment" (Maxwell, AL: Air University Press, 2011), 10, <http://www.au.af.mil/au/aul/school/awc/core/6200-15-spencer-united.pdf>.
- ²⁹ U.S. Department of the Air Force, *Air Force Blue Ribbon Review Nuclear weapons Policies and Procedures*. Washington, DC: Headquarters Air Force, February 12, 2008. <http://www.airforce-magazine.com/SiteCollectionDocuments/TheDocumentFile/Current%20Operations/BRR020808ExecSummary.pdf> (accessed January 7, 2012).
- ³⁰ U.S. Congress. Senate. Committee on Armed Services. *Hearing to Receive Testimony on Air Force Nuclear Surety*. 110th Congress., 2nd sess., February 12, 2008, 5.
- ³¹ U.S. Department of Defense, "Top Air Force Leaders Resign Following Nuclear Component Mishandling," Armed Forces Press Service, June 5, 2008. <http://www.defense.gov/news/newsarticle.aspx?id=50117> (accessed December 23, 2011).
- ³² U.S. Department of Defense, *Report to the Secretary of Defense Task Force on DoD Nuclear Weapons Management; Phase I: The Air Force's Nuclear Mission*, (Washington, DC: Pentagon, September 2008), 2.
- ³³ Ibid, 1-11.

³⁴ Ibid, 49-60.

³⁵ U.S. Department of Defense, *Report to the Secretary of Defense Task Force on DoD Nuclear Weapons Management; Phase II: Review of the DoD Nuclear Mission*, (Washington, DC: Pentagon, December 2008), iii.

³⁶ Ibid, 19-34.

³⁷ Ibid, iv.

³⁸ U.S. Department of Defense, *Report to the Secretary of Defense Task Force on DoD Nuclear Weapons Management; Phase I: The Air Force's Nuclear Mission*, September 2008, 1.

³⁹ Barack Obama. "Prague Speech on Nuclear Weapons." May 6, 2009.

http://www.huffingtonpost.com/2009/04/05/obama-prague-speech-on-nu_n_183219.html

(accessed on January 12, 2012).

⁴⁰ Ibid.

⁴¹ U.S. Department of Defense and U.S. Department of Energy, *National Security and Nuclear Weapons in the 21st Century*, by Robert Gates and Samuel Bodman. Arlington, VA: Departments of Defense and Energy, 2008.

⁴² Arms Control Association, "Fact Sheet: US Nuclear Modernization Programs".

<http://www.armscontrol.org/factsheets/USNuclearModernization> (accessed March 3, 2012).

⁴³ Barack Obama. "Prague Speech on Nuclear Weapons." May 6, 2009.

http://www.huffingtonpost.com/2009/04/05/obama-prague-speech-on-nu_n_183219.html

(accessed on January 12, 2012).

⁴⁴ Senate Committee on Armed Services, *Department of Defense Authorizations for Appropriations for Fiscal Year 2009*, 110th Congress., 2nd sess., April 2008.

BIBLIOGRAPHY

Agnew, Harold. "Letter: Looking for Spies in Nuclear Kitchen", *Wall Street Journal*, p. A27, May 17 1999. <http://www.fas.org/irp/ops/ci/agnewwsj.html> (accessed February 26 2012).

Arms Control Association, "Fact Sheet: US Nuclear Modernization Programs". <http://www.armscontrol.org/factsheets/USNuclearModernization> (accessed March 3, 2012).

Associated Press, "US Mistakenly Ships ICBM Parts to Taiwan." Military.com, <http://www.military.com/NewsContent/0,13319,164694,00.html>.

Boese, Wade. "Bush Seeks Budget Boost for Future Warhead", March 2007, Arms Control Association, <http://www.armscontrol.org/print/2345> (accessed April 20, 2012).

Dulles, John. "The Evolution of Foreign Policy," *Department of State Bulletin*, vol. 30, January 25, 1954.

Fontenot, Jon. "A New Era: SAC to STRATCOM," Master's Thesis, Marine Corps University, 1995).

Halloran, Richard. "Protracted Nuclear War", *Air Force Magazine*, March 2008, <http://www.airforce-magazine.com/MagazineArchive/Pages/2008/March%202008/0308nuclear.aspx> (accessed March 27, 2012).

Hoffman, Michael and William H. McMichael. "15 Officers Disciplined Over Nuclear Botches." *Air Force Times*, September 25, 2008. http://www.airforcetimes.com/news/2008/09/airforce_generals_nuclear_092508/ (accessed January 9, 2012).

Lewis, Jeffrey. "After the Reliable Replacement Warhead: What's Next for the U.S. Arsenal," December 2008, Arms Control Association, <http://www.armscontrol.org/print/3463> (accessed April 19, 2012).

Martin, Patrick. "US shipped Fuses for Nuclear-Armed Missiles to Taiwan." World Socialist Web Site, <http://www.wsws.org/articles/2008/mar2008/nuke-m28.shtml> (accessed January 21, 2012).

Medalia, Jonathan. *Nuclear Weapons: Comprehensive Test Ban Treaty*, CRS Report for Congress RL34394 . Washington, DC: Congressional Research Service, March 12 2008. <http://www.fas.org/sgp/crs/nuke/RL34394.pdf> (accessed January 12, 2012).

National Museum of the Air Force, “50 Years of ICBMs.”

<http://www.nationalmuseum.af.mil/shared/media/document/AFD-090731-063.pdf> (accessed on December 29, 2011).

Obama, Barack. “Prague Speech on Nuclear Weapons.” May 6, 2009.

http://www.huffingtonpost.com/2009/04/05/obama-prague-speech-on-nuclear-weapons_n_183219.html, (accessed on January 12, 2012).

Parrington, Alan. “Mutually Assured Destruction Revisited,” *Airpower Journal*, Winter 1997.

<http://www.airpower.maxwell.af.mil/airchronicles/apj/apj97/win97/parrin.html> (accessed April 1, 2012).

Project of the Nuclear Age Peace Foundation, “Flexible Response”,

<http://www.nuclearfiles.org/menu/key-issues/nuclear-weapons/history/cold-war/strategy/strategy-flexible-response.htm>. (accessed December 27, 2011).

Schwartz, Stephen I., “On Weapons Spending” The Brookings Institute, 1998,

<http://www.brookings.edu/projects/archive/nucweapons/fullnyt.aspx> (accessed April 20, 2012).

Spencer, Michelle, Aadin Ludin, and Heather Nelson. Air University, “United States Air Force Minot and Taiwan Nuclear Weapons-Related Incidents: An Assessment.” Maxwell, AL: Air University Press, 2011, <http://www.au.af.mil/au/aul/school/awc/core/6200-15-spencer-united.pdf>.

The Reagan Vision for a Nuclear Free World, “The Reagan Vision”,

<http://www.thereaganvision.org/the-reagan-vision/> (accessed March 29 2012).

Thielman, Greg. “The Missile Gap Myth and its Progeny.” Arms Control Association, May 2011, http://www.armscontrol.org/act/2011_05/Thielmann (accessed on December 27, 2011).

U.S. Congress. Senate. Committee on Armed Services, *Department of Defense Authorizations for Appropriations for Fiscal Year 2009*, 110th Congress., 2nd sess., April 2008.

U.S. Department of the Air Force, Air Combat Command, *Air Combat Command History*.

<http://www.acc.af.mil/library/acchistory.asp> (accessed January 4, 2012).

U.S. Department of the Air Force, *Air Force Blue Ribbon Review Nuclear weapons Policies and Procedures*. Washington, DC: Headquarters Air Force, February 12, 2008. <http://www.airforce-magazine.com/SiteCollectionDocuments/TheDocumentFile/Current%20Operations/BRR020808ExecSummary.pdf> (accessed January 7, 2012).

U.S. Department of the Air Force, *Reinvigorating the Air Force Nuclear Enterprise*.

Washington, DC: Headquarters Air Force, October 24, 2008.

U.S. Congress. Senate. Committee on Armed Services. *Hearing to Receive Testimony on Air Force Nuclear Surety*. 110th Congress., 2nd sess, February 12, 2008.

U.S. Department of Defense, Office of the Deputy Assistant to the Secretary of Defense for Nuclear Matters, “US Nuclear Stockpile Management.”
<http://www.acq.osd.mil/ncbdp/nm/USNuclearDeterrence.html>

U.S. Department of Defense and U.S. Department of Energy, *National Security and Nuclear Weapons in the 21st Century*. Arlington, VA: Departments of Defense and Energy, 2008.

U.S. Department of Defense, *Nuclear Posture Review 2002*, Washington, DC: Pentagon, January 2002.

U.S. Department of Defense, *Nuclear Posture Review 2010*, Washington, DC: Pentagon, April 2010.

U.S. Department of Defense, *The Quadrennial Defense Review*. Arlington, VA: Department of Defense, February 6, 2006, 48-50. http://www.nuclearfiles.org/menu/key-issues/nuclear-weapons/history/prez_policies/bush2/QDR.pdf (accessed January 15, 2012).

U.S. Department of Defense, *Report to the Secretary of Defense Task Force on DoD Nuclear Weapons Management; Phase I: The Air Force’s Nuclear Mission*. Washington, DC: Pentagon, September 2008.

U.S. Department of Defense, *Report to the Secretary of Defense Task Force on DoD Nuclear Weapons Management; Phase II: Review of the DoD Nuclear Mission*. Washington, DC: Pentagon, December 2008.

U.S. Department of Interior, *Minuteman ICBM Launch Control Facility Delta-01 and Launch Facility Delta-09, Ellsworth Air Force Base*. June 26, 2003.
http://www.cr.nps.gov/history/online_books/mimi/hrsab.pdf

U.S. Department of State, *The Comprehensive Nuclear Test Ban Treaty*. Washington, DC, September 10 1996. <http://www.state.gov/www/global/arms/treaties/ctbt/ctbt-preamble.html>.

U.S. Department of State, *Treaty Between the United States of American and the Union of the Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms*. Washington, DC, January 20, 2001.

Warrick, Joby and Walter Pincus, “Missteps in the bunker,” *The Washington Post*, September 23, 2007. <http://www.washingtonpost.com/wp-dyn/content/article/2007/09/22/AR2007092201447.html> (accessed January 2, 2012).