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NEW CONVENTIONAL WEAPONS, REDUCING RELIANCE ON A NUCLEAR RESPONSE TOWARD AGGRESSORS

by

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Preface

Entering the new millennium, the United States faces a myriad of new international challenges to its national security and interests. The bi-polar environment of the Cold War no longer exists with the former Soviet Union, but unstable entities threaten world peace. Now is the time to methodically review our national and military strategies and develop appropriate response options to those who threaten our nation's security and interests through terrorism and warfare. I staunchly believe that the United States must develop and deploy an integrated missile defense system that protects all 50 states, our forward deployed forces, and allies from Intercontinental Ballistic Missiles (ICBM), Intermediate Range Ballistic Missiles (IRBM), Submarine Launched Ballistic Missiles (SLBM), and cruise missiles launched from the land, sea, or air. Stephen M. Younger's paper, "Nuclear Weapons in the Twenty-First Century," is a must read for those developing U.S. military nuclear strategy.

I want to thank Professors Robert L. Pfaltzgraff, Jr., the Shelby Cullom Davis Professor of International Security Studies and Founder and President of International Foreign Policy Analysis, and Richard H. Shultz, Jr., Director of the International Security Studies Program at the Fletcher School of Law and Diplomacy, Tufts University, for the opportunities, counsel, and advice they provided me during my fellowship. I especially thank Colonel Roger W. Hansen, USAF retired, who epitomizes officership and, is my personal mentor, for his wise guidance and leadership, and his review of this project.

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Abstract

We are in a new era of warfare, one in which our warfighting and strategy paradigms must change due to unconventional threats our nation faces and is further complicated by evolving technology, emerging states, rogue nations, and terrorist groups. With the fall of the Soviet Union, our old nemesis has been beaten, but many of the impulsive entities it formerly sponsored and controlled are now unbridled to act on their own. We face terrorism abroad daily and it now reaches us within our own borders. This paper explores military options to acts of aggression against our citizens, forces and allies that our tactical nuclear weapons stockpile previously held in check during the Cold War. I do not advocate totally removing the tactical or limited nuclear options or doing away with our strategic nuclear shield, only that we have the means to reduce the tactical nuclear stockpile size given new conventional weaponry technology and its ability to pick up some of the missions/targets previously assigned to nuclear weapons. To develop my premise, I will first review the historical account of our nation's nuclear policy, explore emerging threats the United States and our allies face, examine new conventional weapons, and finally, provide a range of military options to acts or threats of terrorism or warfare against the United States or our allies.

The main reason the United States developed tactical or low-yield nuclear weapons was to defeat an overwhelming conventional military superiority the former Soviet Union had, such as armor poised for attack in former Warsaw Pact nations. In fact, a new

family of nuclear weapons was developed specifically to counter the overwhelmingly superior numbers of Soviet armor that threatened NATO forces in the 1970s and 1980s – the neutron bomb. Throughout his presidential campaign, President George W. Bush stated he wanted to reduce America's nuclear arsenal to retain only the amount of nuclear weaponry to deter potential aggressors and provide an adequate response if deterrence failed. He recently ordered a thorough review of the U.S. national strategy, nuclear strategy, defense systems and responses to threats of our nation's vital interests and security. A nuclear posture review was already scheduled for the end of the summer of 2001 and may now be accelerated in light of his recent directions. In addition, the new administration has taken its case for a national missile defense system to the international community and is aggressively expounding how it will be in the best interest of the global community to develop and implement such a system. Our NATO allies are beginning to comprehend how such a system can benefit them as well as the international community as a whole. Russia vehemently denounces this concept although they have an Anti-Ballistic Missile (ABM) capability and the U.S. National Missile Defense (NMD) could conceivably include defense of their nation by integrating their defense network as well as other nations with this capability. If a missile launch can be quickly detected and effectively destroyed in time, there may not be the need for a nuclear response to those responsible and could prevent an accidental nuclear war between the world's nuclear powers. Current Intelligence, Surveillance, and Reconnaissance (ISR) assets are capable of detecting construction of launch facilities, Weapons of Mass Destruction (WMD) facilities or command and control underground facilities, or other threats to international peace and security.

Chapter 1

US Nuclear Policy Review

The release of atomic energy has not created a new problem. It has merely made more urgent the necessity of solving an existing one.

Albert Einstein

The Beginning

From 1945 through 1991, the United States' primary national strategy challenge was to prevent communist expansion throughout the world and its threat to democratic societies. The greatest threat to the U.S., NATO and their allies during this bi-polar era came from the Soviet Union and its activities to spread the communist doctrine. With the collapse of the German Third Reich, the Soviet Union wanted to ensure that it would never again be invaded as it had been twice before in the 20th Century, as well as to expand its communist doctrine and influence throughout the world. Russian expansionism began when its forces drove Nazi forces from countries surrounding Russia, then installed communist governments at the end of World War II. Stalin solidified his hold on those nations under Soviet control through real and threatened intimidation and through the establishment of the Warsaw Pact. He equipped these nations with large numbers of Soviet military equipment and "advisors" who actually controlled the power, political and military, within their borders. The Soviet Union continued to build large, modern conventional forces and fervently worked to obtain the

nuclear capability that the United States had developed and employed in World War II and that it was enhancing in the late 1940s and 1950s. The Soviet Union's detonation of a nuclear bomb in 1949 sent shock waves throughout the world as it was thought they would not have this capability until 1959. In 1957, the Soviet Union again caused great international concern when it launched Sputnik into orbit, proving it now had an intercontinental ballistic missile capability and could target any point in the world within minutes. During the 1950s through the 1980s, the USSR continued building up its conventional forces, outstripping the western nations' conventional military capabilities in Europe, as well as advancing its nuclear weapons program. The bi-polar arms race continued to escalate until the late 1980s when the Soviet economy could no longer sustain the immense drain on its resources and the Soviet leadership recognized it was in a state of imminent collapse. Throughout this period, the western nations aligned with the United States also continued buildup of conventional and nuclear forces to offset the Soviet Union's threat, but they greatly lagged in conventional military capabilities, especially armor. To counter the higher numbers of the Warsaw Pact conventional forces, the U.S. deployed tactical nuclear weapons to NATO countries, thus extending the protective nuclear umbrella. The world's largest and most devastating war was avoided through the use of conventional and nuclear deterrence. The U.S. must continue to adapt deterrence to meet evolving threats of the twenty-first century as deterrence is primarily designed to prevent wars from starting.

Deterrence Defined

The Department of Defense dictionary defines deterrence as "The prevention from action by fear of the consequences. Deterrence is a state of mind brought about by the

existence of a credible threat of unacceptable counteraction." For deterrence to be an effective strategy to counter adversaries, it must have credible capabilities, planning, and the nation's leaders must display a willingness to use those forces if deterrence fails. To understand deterrence strategy, one must review its three essential elements: retaliation, denial, and dissuasion.

Retaliation: the primary element of the U.S. deterrence policy throughout the Cold War was the prospect of a prompt and unacceptable level of retaliation in response to nuclear or conventional aggression. The logic of deterrence required that the United States be able to destroy those targets it believed the leadership of the Soviet Union most valued: conventional and nuclear forces; leadership, and industrial facilities that supported military and political power of the state. To be credible, the threat of retaliation had to be backed by responsive, effective and survivable forces that were made up of the United States strategic Triad: manned bombers, ICBMs and SLBMs. Further flexibility was provided by theater (sub-strategic or non-strategic) nuclear weapons that were integrated with combat forces to deter a massive conventional attack by the Warsaw Pact through the Fulda Gap which would have overwhelmed NATO conventional forces. The United States could no longer rely solely on mobilization of resources after the onset of a crisis, as it had done twice before in the 20th Century.[1]

Denial: Denying an adversary the ability to achieve his goals through military means, that is blunting or negating the effectiveness of his forces, was another means of strengthening deterrence during the Cold War. Before the advent of ICBMs and SLBMs, air defenses against Soviet bombers played the primary role in the U.S. deterrent posture. Passive defense, in the form of civil defense measures, also enhanced deterrence. With

the advent of long-range ballistic missiles – and the adoption of the mutual assured destruction doctrine – defenses were given a much reduced role. The 1972 ABM Treaty codified strict limits on strategic defenses and thereby accepted the vulnerability of the U.S. population to Soviet nuclear attack. From the mid-1980s through today, the United States greatly expanded research and development aimed at giving active missile defenses increased weight in the deterrence concept.[2]

Dissuasion: During the Cold War, the United States possessed a range of other capabilities that helped convince potential adversaries of the ultimate futility of large-scale military aggression. For example, in addition to U.S. economic strength and political leadership, the highly visible research and development, production, technology, and industrial base of the United States enabled it to deploy forces that would deter nuclear attack, and portrayed a national commitment to counter any threat. This posture not only conveyed existing U.S. capabilities, but its overall long-term potential of what it could develop, deploy and employ in the future. Former Soviet officials have cited the IRBM deployments, Strategic Defense Initiative (SDI), the computer revolution coupled with export controls, and the expanding western economy as factors that convinced the Soviet leadership of the futility of attempting to sustain the strategic competition for an indefinite future would result in a situation they would find untenable. Recognizing the decay and near bankruptcy of their own industrial and societal base, the Soviet leaders understood the need to transform their system fundamentally, a process that unleashed the forces that brought down the Soviet state.[3]

Cold War Deterrence

> *If peace is viewed as the absence of general war among the major states, the world has enjoyed more years of peace since 1945 than has been known in this century; and nuclear weapons have been a major force working for peace in the post-war world. They make the cost of war seem frightenly high, and thus discouraged nations from starting wars that may lead to their use.*
>
> David M. Kerr
> Director 1979 – 1985
> Los Alamos National Laboratory

During the Cold War, the threat of U.S. nuclear retaliation deterred the Soviet Union from launching either a direct conventional or nuclear attack on the west. Soviet leaders knew that their most valued assets were placed at risk and that U.S. retaliatory forces were survivable. The existence of alliances was the basis for establishing commitment for using force. The long period of time of U.S.-Soviet relationship provided both sides the knowledge of each others military doctrine, military forces and political goals. This, in turn, provided for rational governments whose actions could be calculated, were somewhat stable, and backed by large military forces, including large nuclear arsenals. Direct warfare was averted primarily due to threats of swift retaliation by each side while both could maintain large survivable nuclear and conventional forces.

Post-Cold War Challenges

Deterrence for the Post-Cold War setting presents much more difficult challenges due to the unpredictability of non-state actors, rogue states and emerging nuclear states. U.S. deterrence strategy for the 21st Century must rely less on retaliation while placing much more emphasis to denial due to the capricious nature of the actors listed above. The U.S. faces great uncertainty about what those who possess WMD value most and

what motivates them into not attacking with WMD. In addition, greater numbers of non-state actors, including terrorist groups, may not be readily identifiable or targeted. WMD may be the weapons of choice rather than last resort for these groups as they are viewed as the weapons of the weak against the strong. No one can really be sure about control or safety mechanisms, human and mechanical, for such weapons that are controlled by these groups. One only needs to look at the attack on the USS Cole, and see the frustration at trying to link the terrorists to an organization, individual or state and the immense complexity of planning an appropriate retaliatory response to the responsible actor without harming the U.S. international credibility or stature.

Post Cold War Deterrence Requirements

The U.S. still uses planning tools for nuclear responses dated back to the Cold War era. The Single Integrated Operations Plan (SIOP) is focused on a massive counterattack strategy that aims to eliminate the ability of an adversary to inflict further damage to American interests.[4] Due to the increasing numbers and types of actors, one type of deterrent threat will not fit all categories or situations. Deterrence will require accurate and timely intelligence about values, doctrines, goals, capabilities, and intentions of these diverse adversaries. Deterrence will have to be tailored to specific situations, versus specific governments, across a broad conflict spectrum from high to low intensity, including state and non-state actors. The U.S. will have to develop a greater mix of offensive and defensive capabilities and integrate conventional, as well as nuclear, forces into these deterrence capabilities more than was done in the Cold War era. As more emphasis is placed on deterrence through denial, active and passive defenses will grow with importance as will intelligence gathering and dialogue with these new potential

adversaries. A nuclear retaliatory response to these groups and states may not be an option due to the location of friendly forces and friendly states because of the harm a nuclear explosion would bring. Also, world opinion toward the U.S. in crossing the nuclear threshold would be overwhelmingly negative depending on the circumstances. Again, looking at the USS Cole incident, if the U.S. attempted a nuclear attack on the Osama bin Laden organization in the sovereign state of Afghanistan, it would be under world condemnation. The U.S. must hold in its quiver a powerful, extremely accurate and lethal conventional retaliatory response using accurate and timely intelligence that will cause potential adversaries not to even contemplate a WMD or conventional attack on the U.S., its vital interests, allies or forward deployed forces. This conventional attack capability must be accurate, capable of destruction of a wide range of targets, including hardened and well defended, be capable of total surprise, and be survivable. An example of this was the U.S. conventional military response to Osama bin Laden's attack on the U.S. embassies where many of his facilities were hit as well as a meeting house and terrorist camp using conventionally armed cruise missiles. The U.S. deterrence strategy of solely relying on a nuclear response to a WMD attack must change using the newer conventional weapon capabilities it now possesses and is enhancing. France's, India's, and Pakistan's recent nuclear testing shows that the world's nations and organizations, like the UN, have a disdain for any above ground nuclear detonation, whether in testing or as retaliation, and will not favorably treat nations that perform these operations. Even the U.S. use of the two nuclear bombs to end WWII is now being called into question. Looking at responses of world leaders and organizations to nuclear explosions and

incidents over the past two decades, one must draw the conclusion that nuclear weapons true utility is for deterrence, and failing that, swift retaliation for a nuclear attack.

Challenges to the Current Nuclear Stockpile

As stated in the abstract, President Bush has stated that he wants a full and thorough review of the current U.S. nuclear stockpile and its capabilities. This will be accomplished later this year during the 2001 Nuclear Posture Review (NPR) when high-level strategists and defense officials will meet to review the U.S. nuclear strategy, including weaponry, Command, Control, and Communications (C^3), stockpile stewardship, and current and emerging threats. In an Associated Press article, published and dated January 27, 2001, the President pledged to fulfill his campaign promise to reduce the U.S. nuclear forces while deploying a national missile defense system. He and Secretary of Defense Rumsfeld reiterated this stance in an article posted on CNN's website on February 9, 2001 in which it was stated that unilateral reductions in the U.S. nuclear arsenal may gain support from allies for the U.S. developing and deploying an NMD system. The President declared that he wants to lead the world toward a safer world when it comes to nuclear weaponry. He emphasized the point of reducing U.S. nuclear forces commensurate with the nation's ability to keep the peace. The first in-depth NPR was chartered in 1993, signed by the President in 1994 and represented the first thorough review of U.S. nuclear strategy in 15 years. One of the most significant problems with the United States nuclear weapons program is the unilateral self-imposed weapons testing ban.[5] Nuclear scientists and engineers are hindered in verifying the current stockpile's condition due to aging of the nuclear components, as well as any testing of new weapons technology. Emerging nuclear technology could produce

weapons of much lower yields, adaptation of desired effects such as electromagnetic energy to defeat an aggressor's communications or electrical systems, but nuclear testing would have to be accomplished for these newer weapons to be considered safe and reliable.[6]

Maintaining the Current Stockpile

When the Cold War ended, the U.S. nuclear stockpile consisted of highly optimized warheads and bombs that could be and were mated to highly reliable missiles and aircraft. These most advanced weapon systems in the world were designed to counter a massive Soviet threat and current plans call for them to be retained indefinitely. These weapons are safe, reliable, and meet performance requirements while new warheads of comparable capability are difficult or impossible to field without nuclear testing. Current nuclear warheads can be modified in many ways for changing military requirements as was done when the B61 bomb was modified for earth-penetrating capability. However, refurbishment and other changes will be made to aging warheads and bombs that may be difficult to certify without nuclear testing. Also, the costs of maintaining these weapons are high for both the DoD and DoE. An extensive infrastructure of laboratories and plants is required for the Stockpile Stewardship program, including a new manufacturing capability for plutonium pits. The stockpile, as currently configured, may not be a credible deterrent against some potential adversaries due to the overkill of high nuclear yield.[7] For instance, if a terrorist organization carried out a limited WMD attack against the U.S. and the organization was located, would the U.S. be willing to use a nuclear response as retaliation? Would the threat of an SLBM or ICBM response truly deter the leaders of such organizations? As Stephen Younger states in his paper, "such a reliance

on high-yield strategic weapons could lead to "self-deterrence," a limitation on strategic options, and consequently a lessening of the stabilizing effect of nuclear weapons."[8]

Table 1. U.S. Nuclear Forces

Type	Name	Launchers	Year deployed	Warheads x yield (kiloton)	Total warheads
ICBMs					
LGM-30G	Minuteman III:				
	Mk-12	200	1970	3 W62 x 170 (MIRV)	600
	Mk-12A	300	1979	3 W78 x 335 (MIRV)	900
LGM-118A	MX/Peacekeeper	50	1986	10 W87 x 300 (MIRV)	500
Total		**550**			**2,000**
SLBMs					
UGM-96A	Trident I C-4	192/8	1979	8 W76 x 100 (MIRV)	1,536
UGM-133A	Trident II D-5	240/10			
	Mk-4		1992	8 W76 x 100 (MIRV)	1,536
	Mk-5		1990	8 W88 x 475 (MIRV)	384
Total		**432/18**			**3,456**
Bombers*					
B-2	Spirit	21/16	1994	ALCM/W80-1 x 5–150	400
				B61-7/-11, B83 bombs	950
B-52H	Stratofortress	94/56	1961	ACM/W80-1 x 5–150	400
Total		**115/72**			**1,750**
Non-strategic forces					
Tomahawk SLCM		325	1984	1 W80-0 x 5–150	320
B61-3,-4,-10 bombs		n/a	1979	0.3–170	1,350

*First bomber number reflects total inventory. Second bomber number is "primary mission" number which excludes trainers and spares. Bombers are loaded in a variety of ways depending on mission. B-2s do not carry ALCMs or ACMs. The first 16 B-2s initially carried only the B83. Eventually, all 21 bombers will be able to carry both B61 and B83 bombs. B53 bombs have been retired and were replaced with B61-11s.

ACM—advanced cruise missile; ALCM—air-launched cruise missile; ICBM—intercontinental ballistic missile (range greater than 5,500 kilometers); MIRV—multiple independently targetable reentry vehicles; SLCM—sea-launched cruise missile; SLBM—submarine-launched ballistic missile.

Source: Bulletin of Atomic Scientists, *Nuclear Notebook*, Robert S. Norris and William M. Arkin Natural Resources Defense Council, 1200 New York Avenue, N.W., Suite 400, Washington, D.C., 20005

Modifying Existing Designs of the Current Nuclear Stockpile

One could consider a "flexible stockpile" strategy that takes advantage of the flexibility inherent in current nuclear weapon designs, that is modifying current weapon

types to meet evolving military needs. It is conceivable to tailor output weapons for special applications such as those that could produce an enhanced electromagnetic pulse for disabling electronics or enhanced radiation for the destruction of chemical or biological weapons, factories or stockpiles with low collateral damage. Many in the weapons community doubt these types of systems could be relied upon without significant nuclear testing. Highly optimized nuclear weapons may be more efficient, but efficiency may come at the cost of complexity of maintenance. Without nuclear testing, small changes caused by aging or required component replacements will introduce uncertainty into the stockpile and this uncertainty must be figured into military strategy and operations.[9] Once again, the United States self-imposed ban on nuclear testing would have to be lifted to ensure the effectiveness and safety of these weapons. If the ban was temporarily lifted, the United States may find itself facing a negative world opinion and could cause emerging nuclear states to accelerate their nuclear weapons building programs to include nuclear testing of their arsenals.

Target Sets Currently Assigned to Nuclear Weapons

Current United States nuclear strategy is one that focuses on counterforce rather than countervailing strategy of the 1970s. SIOP-6 was formulated using Nuclear Weapons Employment Policy (NUWEP)-80 placing emphasis on Soviet leadership and relocatable targets.[10] Using this as a starting place, United States nuclear weapons are likely targeting hardened command and control facilities, hardened ICBM complexes, mobile ICBM staging areas, hardened WMD storage facilities, SLBM and submarine support facilities, and SLBM staging locations. One example of potential targets that have been effectively threatened using nuclear weapons is the case of the Libyan Tarhunah

underground chemical plant. In 1996 through 1997, the Clinton Administration, through former Secretary of Defense William Perry, made public its intention to attack this plant, with "the whole range of American weapons" if Libyan leader, Moammar Gadhafi, did not halt construction on what the United States considered the largest chemical weapons facility in the world. U.S. nuclear weapons experts immediately began modifying the B61 nuclear bomb to specifically destroy targets such as the Tarhunah underground facility by giving it a deep penetration capability.[11] The adaptation of the B61 tactical nuclear weapon, B61-11 to destroy deeply buried, hardened facilities now places this version into the strategic family of nuclear weapons.

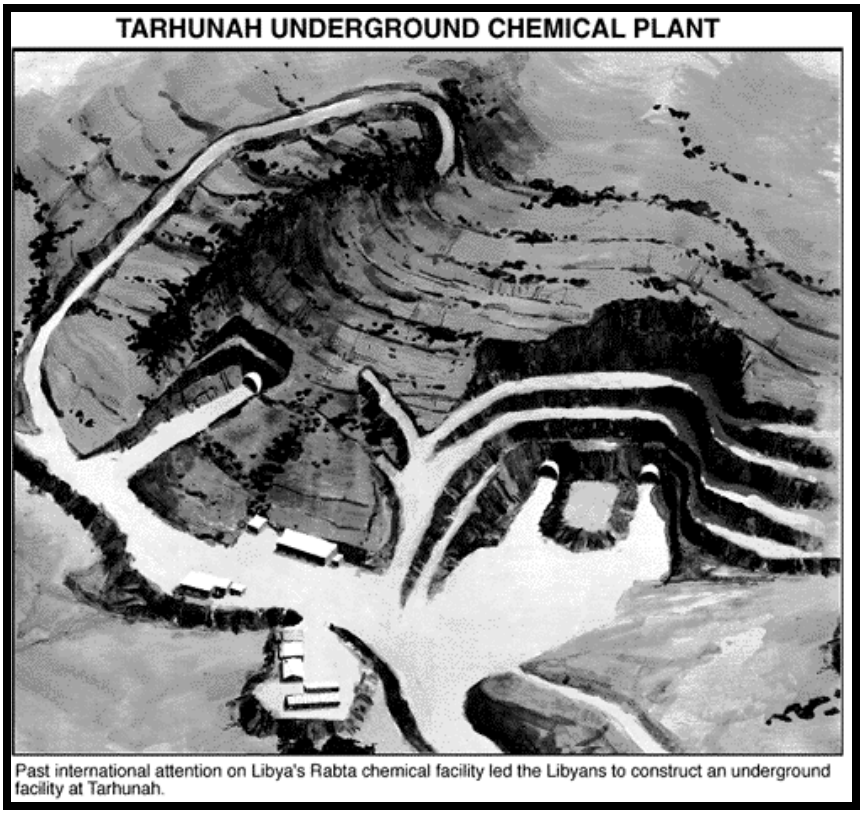

Figure 1. Artist's rendering of the Tarhunah complex based on photoreconnaissance sources

Source: Office of the Secretary of Defense, ***Proliferation: Threat and Response***, April 1996, p. 27

The Libyans halted construction on the plant, but it is still kept under close scrutiny by the United States intelligence network. For many years the B53 and W53 weapons were the mainstay of the U.S. nuclear arsenal for striking deeply buried, hardened targets. Due to technical reasons, these strategic nuclear weapons were removed from the arsenal and were replaced by the B83, B61-7 and B61-11. It is not known what the nuclear yields of the B61-7 and -11 are, but are recognized as targeting hardened underground facilities.[12]

Tactical Nuclear Weapons

Today, B61-3, -4, and –10 weapons are thought to be the only class of nuclear weapons deployed outside of the U.S. According to the Bulletin of American Scientists Nuclear Notebook, approximately 150 of these weapons are located at various locations in NATO countries with the exception of the newest member states, but are under strict U.S. control.[13] These weapons were placed there during the Cold War and the strategy for keeping them there after the collapse of the Soviet Union has not been thoroughly reviewed. It is unlikely that deployed tactical nuclear weapons are any longer targeted against specific armor or conventional military staging areas. Some NATO countries are now publicly stating they want to review tactical nuclear weapons utility and whether there is a need to retain these nuclear weapons within their borders. Officially, these weapons are not targeted against Russia: a 1996 NATO document stated that nuclear weapons "are no longer targeted against anyone."[14] The remaining question, therefore, is who is the potential target, since the negative guarantees adopted in connection with the Nuclear Proliferation Treaty (NPT) preclude the United States from threatening non-nuclear states with nuclear weapons?[15]

It is in the security interests of the democracies of Europe and North America to address concerns regarding the Russian Federation nuclear weapons program. While U.S. nonstrategic nuclear forces still have a role in Europe today, their perceived value and utility are gradually fading, at least in the eyes of some observers. In fact, their final utility may be their role as bargaining chips to induce the Russian Federation to eliminate entirely this category of weapons.[16]

Chapter 2

Emerging Threats

> *"Let every nation know, whether it wishes us well or ill, that we shall pay any price, bear any burden, meet any hardship, support any friend, oppose any foe, to assure the survival and success of liberty."*
>
> President John F. Kennedy

When President Kennedy spoke the words above, the world was bi-polar and, for the most part, sovereign nations controlled radical groups and organizations within their borders. There were few rogue nations, Libya was emerging; few failing states, Lebanon was starting down this path; and few independent organizations that had an international impact, the Palestinian Liberation Organization had begun to sponsor international terrorism. Had President Kennedy been faced with more of these types of potential aggressors, he may have replaced the word, "nation" with a more descriptive phrase to include the groups described above. President George W. Bush, Secretary of State Colin L. Powell, and Secretary of Defense Donald H. Rumsfeld must now revise U.S. national strategy and defense posture to deal with these elements. The United States can no longer ignore the threats these potential aggressors pose to the U.S., its citizens, armed forces, allies, or national interests.

In the 1960s, there were five declared nuclear nations: the U.S., the Soviet Union, China, France, and the United Kingdom. Today, we must include India, Pakistan, and,

although not declared, Israel. WMD, not just nuclear weapons, are beginning to spread throughout the middle-east, southwest, and northern Africa. Advanced delivery systems, specifically missile technology, are also spreading in these same areas as well as future martyrs being groomed in terrorist training and staging camps to deliver these weapons. One only has to look at the recent USS Cole attack to comprehend what conventional explosives can do with so called martyrs ready to give up their lives. But, how quickly can a crew of a U.S. warship react going through the Suez Canal, if it were to be attacked by extremist "martyrs" using mortar tubes firing small projectiles filled with biological or chemical agents designed to detonate in an airburst just above the ship? The same can be said of American military aircraft, either a single aircraft or numbers of aircraft, transiting airfields in friendly sovereign nations being attacked in the way while the crews and/or passengers are near or on the aircraft. These aircrews or ships' companies do not normally keep their chemical protective gear at hand while transiting key choke points.

The following paragraphs cover some of these threats that the U.S. faces. These are not by any means all-inclusive, but only some highlights that were noted in this research.

Russia

With the demise of the Soviet Union, Russia retained much of the diplomatic and strategic resources of the former Soviet Union. For instance, Russia retains the permanent seat on the United Nations Security Council that the Soviet Union once held. Russia removed most of the Soviet Union's WMD and strategic military capabilities back within its borders. Although its military capability has greatly declined, no one should deceive themselves in believing that Russian military forces are totally benign. In fact, although Russia's conventional military capability has significantly declined, it depends

heavily on its nuclear forces to make up the deficit.[17] Russia attempted to show the world its military capabilities were still viable in June 1999. On June 25, two TU-95 Bear bombers flew within 60 miles of Iceland as part of an extensive series of Russian war games called West-99. They were intercepted by four U.S. F-15 fighters and a P-3 training aircraft, U.S. officials said. West-99 involved as many as 50,000 troops from five military districts and three naval fleets. The exercise involved more than 30 ships, four submarines--including the nuclear-powered *Kirov* as well as Russian Air Force and Navy aircraft capable of launching air-to-air and air-to-ground cruise missiles.[18]

Even today, Russia is attempting to manipulate international opinion and decisions using outdated Cold War, bi-polar strategy and philosophy. On April 14, 2000, the START II Treaty was finally ratified by the Russian Duma, opening the way for a possible START III Treaty. START II was signed in January 1993 and ratified by the U.S. Senate on January 26, 1996. After his election in March, Russian President Vladimir Putin stated that Russia would not implement the treaty if the United States went ahead with plans to deploy a National Missile Defense system.[19] Rather than moving into the 21st century and countering threats that are significant to both nations' security, Russian leaders are intent into returning to Cold War strategies and thinking. Russia should realize that an integrated anti-missile system could conceivably cover many of the world's nations and would not be designed to defeat a massive missile attack, but only defend against a few missiles that an irrational antagonist could launch toward the U.S., Europe, or even Russia. After being invaded twice in the past century, is Russia comfortable being open to an attack on her territory by a rogue nation or terrorist organization after openly stating at the end of WWII, "Never again?" Russia still

maintains an enormous arsenal of nuclear weapons and delivery systems, although the author believes they cannot continue to maintain this large stockpile safely or securely in the near- or long-term while attempting to overcome decades of financial ruin due to Communist rule.

Table 2. Russian Strategic Nuclear Forces

Strategic forces

Type	Name	Launchers	Year deployed	Warheads x yield (kiloton)	Total warheads
ICBMS					
SS-18	Satan	180	1979	10 x 550/750 (MIRV)	1,800
SS-19	Stiletto	150	1979	6 x 750 (MIRV)	900
SS-24 M1/M2	Scalpel	36/10	1987	10 x 550 (MIRV)	460
SS-25	Sickle	360	1985	1 x 550	360
SS-27	Sickle	20	1998	1 x 550	20
Total		756			3,540
SLBMS					
SS-N-18 M1	Stingray	176	1978	3 x 500 (MIRV)	528
SS-N-20	Sturgeon	60	1983	10 x 200 (MIRV)	600
SS-N-23	Skiff	112	1986	4 x 100 (MIRV)	448
Total		348			1,576
Bomber/weapons					
Tu-95 MS6	Bear H6	29	1984	6 AS-15A ALCMS or bombs	174
Tu-95 MS16	Bear H16	34	1984	16 AS-15A ALCMS or bombs	544
Tu-160	Blackjack	6	1987	12 AS-15B ALCMS, or 12 AS-16 SRAMS, or 12 bombs	72
Total		69			790
Grand total					~6,000

ALCM—air-launched cruise missile; **AS**—air-to-surface missile; **ICBM**—intercontinental ballistic missile, range greater than 5,500 kilometers; **MIRV**—multiple independently targetable reentry vehicles; **MRV**—multiple reentry vehicles; **SLBM**—submarine-launched ballistic missile; **SRAM**—short-range attack missile; **SSBN**—nuclear-powered ballistic missile submarine; **SAM**—surface-to-air missile.

Source: Bulletin of Atomic Scientists, *Nuclear Notebook*, Robert S. Norris and William M. Arkin Natural Resources Defense Council, 1200 New York Avenue, N.W., Suite 400, Washington, D.C., 20005

Table 3. Russian Non-Strategic Nuclear Forces

Non-strategic forces

	Launchers	warheads
Strategic defense		
SAMS	1,200	1,200
Bombers & fighters	400	1,600
Naval		
Aircraft	140	1,600
Cruise missiles		500
Anti-submarine	n/a	300
Total		~4,000

Source: Bulletin of Atomic Scientists, *Nuclear Notebook*, Robert S. Norris and William M. Arkin Natural Resources Defense Council, 1200 New York Avenue, N.W., Suite 400, Washington, D.C., 20005

Russia no longer poses the immediate military threat to the U.S. or NATO that it once did during the bi-polar, Cold War era, but the rapid decline of all Russian military forces is of great concern to the international community. One only has to look to the recent *Kursk* disaster to see the large-scale capabilities of the Soviet Union no longer exists, but the stability, safety and security of Russia's nuclear forces causes international consternation. These concerns are exacerbated by the uncertainty of Russia being able to pay the members of its forces or sustain the maintenance and infrastructure of the weapon systems themselves. The world community must pressure Russia to reduce its nuclear arsenal to manageable levels and drop its objections to a U.S. NMD program. The instability Russia cites concerning the U.S. NMD system, is much greater given the safety and security of its own massive nuclear stockpile. Although Russia heavily relies on its nuclear forces to make up its shortfalls in conventional forces, recent defense articles in the Foreign Broadcast Information Service, indicate that Russia seeks to reduce its nuclear stockpile to 1,000 warheads if the U.S. will reduce its level. Now may be the time for the U.S. to work with Russia in reducing the levels of nuclear weapons before the Russian warheads are proliferated to other entities.

China

China is beginning to emerge as a regional power and has shown its aggressive stance by attempting to influence various events on Taiwan. A few years ago, China attempted to affect the outcome of elections on Taiwan by firing missiles over and near the island in an attempt to coerce Taiwanese to accept China's sovereignty over the small nation. The U.S. responded with not one carrier battlegroup, but with two to the region,

shocking the Chinese political and military leadership. China's realization of its military shortcomings and the U.S. resolve over a free Taiwan and access through the Taiwanese Straits set it on a course to greatly improve its military capabilities. China is actively pursuing its nuclear weapons program, including upgrading its weapons delivery systems. Its single Fleet Ballistic Missile Submarine (SSBN) submarine has limited capability and is not thought to have traveled outside of China's regional waters. The 12 SLBMs the Xia-class SSBN carries are thought to have a range of 1,020 miles and armed with a single 200 – 300 kiloton warhead. China is working on a new SSBN submarine capable of carrying a new 4,800 mile range SLBM armed with single 200 – 300 kiloton warhead. China is also enhancing its small ICBM force with two new types of ICBMs capable of reaching anywhere on the globe. It is unclear whether the new ICBMs will be fitted with single warheads, MRV'd, or MIRV'd, or what type of nuclear yield these warheads will have. Chinese manned bomber capability is extremely limited with its main bomber being of 1950s-vintage. The Hong-6 is based on the Russian Tu-16 Badger, and has been produced in China since the 1960s. China is upgrading its fighter-bombers with Su-27 Flanker aircraft. The Chinese bought 26 Su-27 aircraft from Russia and has bought the rights to produce a Chinese variant known as the Hong-7, but this aircraft is not thought to have a nuclear capability. Therefore, the majority of Chinese nuclear weapons capability will be directed toward ballistic missile delivery systems that will be operational within the next 10 – 20 years, giving them a vastly improved intercontinental nuclear capability.[20]

Table 4. Chinese Nuclear Forces

Type	NATO designation	Number	Year deployed	Range (km)	Warhead x yield	Number of warheads
Aircraft*						
H-6	B-6	120	1965	3,100	1–3 x bomb	120
Q-5	A-5	30	1970	400	1 x bomb	30
Land-based missiles**						
DF-3A	CSS-2	40	1971	2,800	1 x 3.3 Mt	40
DF-4	CSS-3	20	1980	5,500	1 x 3.3 Mt	20
DF-5A	CSS-4	20	1981	13,000	1 x 4–5 Mt	20
DF-21A	CSS-5	48	1985	1,800	1 x 200–300 kt	48
DF-31	CSS-?	0	2000 ?	8,000	MRV x ?	?
Nimrod	CSS-?	0	2010 ?	12,000	MRV x ?	?
SLBMs***						
Julang-1	CSS-N-3	12	1988	1,700	1 x 200–300 kt	12
Julang-2	CSS-NX-4	0	2010 ?	8,000	1 x 200–300 kt	?
Tactical weapons						
Artillery/ADMs/Short-range missiles (M-9 or M-11)					low kt	120

*Figures for bomber aircraft are for nuclear-configured versions only. Hundreds of aircraft are also deployed in non-nuclear versions. Aircraft range is equivalent to combat radius. Assumes 150 bombs for the force, with yields estimated between 10 kilotons and three megatons. **Dong Feng means "East Wind." ***Julang means "Giant Wave." The Chinese define missile ranges as follows: short-range, <1,000 kilometers; medium-range, 1,000–3,000 kilometers; long-range, 3,000–8,000 kilometers; and intercontinental range, >8,000 kilometers.

ADM—atomic demolition munition; **MRV**—multiple independently targetable reentry vehicles; **SLBM**—submarine-launched ballistic missile.

Source: Bulletin of Atomic Scientists, *Nuclear Notebook*, Robert S. Norris and William M. Arkin Natural Resources Defense Council, 1200 New York Avenue, N.W., Suite 400, Washington, D.C., 20005

Rogue States

It is no secret that Libya, Iran, Iraq, and North Korea are the leaders of a group of sovereign states that wish ill will on the United States. It is also no secret that these nations are aggressively pursuing either WMD and/or ballistic missile technology. In a March 12, 2001 Newsweek article, Secretary of State Powell states that Saddam Hussein "is getting more money now than he was getting in 1990" due to the relaxation of sanctions against Iraq. The article continues that "new reports show that Indian firms are supplying Saddam with chemical and other potential WMD components" and "that German intelligence estimates that Saddam might be able to fire missiles with a 2,000 mile range by 2005."[21]

Although the United States should not worry about a nuclear strike launched by these states from their own soil within the next 10 years, it must prepare now to prevent them from initiating small WMD strikes using missile platforms or suicide attacks. The U.S. must use every ISR asset it now has and will have in the future to continue strict vigilance over these rogue states' actions. In addition, U.S. intelligence organizations must greatly improve and increase its human intelligence (HUMINT) gathering activities. If any one of these impulsive nations obtains WMD and effective delivery systems, the U.S. will be placed in harm's way to the point the nation or our allies could be blackmailed into acquiescing to outrageous demands of these rogue states' leaders. It is thought that these states have some capability (Scud missiles and cruise missiles) which can be used regionally. If these nations desire to remain anonymous in a WMD attack on the U.S., they can easily employ or support terrorist groups with the means to assail the U.S. Rogue states and non-state actors pose the greatest threat to the U.S. and the free world, as these groups will be more inclined to use WMD if they obtain the weapons and have a means to deliver them. Afghanistan is beginning to emerge as one of those states harboring terrorists and that tacitly supports these type of organizations. It is reported that Afghanistan's ruling Taliban will expel Osama bin Laden in return for U.S. recognition of its government – a type of blackmail in search of legitimacy. Libya has been fairly quiet since the U.S.' retaliation for the disco bombings in Germany and the Pan Am flight 103 bombing in 1988, but must be watched with a wary eye.

Non-State Actors

Terrorist groups are no longer the fragmented organizations they were before the 1970s. They are now well organized, thanks to new technology like the Internet, and are

easily able to obtain funds from sponsoring states, innocent and unsuspecting organizations, as well as from their members like Osama bin Laden. Osama bin Laden's group, al Qaeda, is thought to have trained and equipped those who carried out the attacks on U.S. Rangers in Mogadishu, Somalia and on the USS Cole. In addition, Osama bin Laden actively sought to obtain Stinger ground-to-air missiles and an aircraft in the 1990s in his terrorist efforts against the U.S.[22] It is extremely frustrating to stop resources and technology going to these groups and just as difficult to retaliate against them since they are widely dispersed or within a sovereign state's borders. Although the U.S. responded to Osama bin Laden's attack on the two embassies, it was unable to effectively target the mastermind of the plan. The U.S. was able to hit a terrorist meeting house, some portions of his camps and one of his chemical/biological facilities, but at a cost of some world condemnation. The U.S. retaliation was carried out using conventionally armed cruise missiles and hit terrorist targets in several countries. Osama bin Laden has been given sanctuary by the Taliban in Afghanistan and receives support from rogue states and irrational religious fundamentalists. Osama bin Laden and al Qaeda have shown they are willing to carry out attacks against the U.S. inside and outside of the U.S. borders at will. In a CNN article dated February 12, 2001, other organizations, such as Hamas, Hezbollah, and the Islamic Jihad are willing to target all supporters of Israel, especially U.S. interests or forces.[23] If these organizations obtain or build any type of WMD, regardless of the amount, it will not hesitate to use these weapons against Israel first, then against Israeli allies. These are only a few of the groups that have targeted U.S. forces, citizens, property, and allies. There are countless other groups that would not hesitate to target U.S. interests if they have the opportunity, means,

and support to carry out their attacks – even suicidal attacks as have been recently noted in the news.

Unlike terrorist groups in the 1960s and 1970s who were more or less controlled and supported by the Soviet government and other communist entities, today's terrorist groups are mostly unencumbered by controlling states. The only exception is if a group's actions can be traced back to a sovereign nation's borders or given active support by these rogue nations as was done in Afghanistan and Libya. It is not within these nations' interests to be linked to a terrorist act, as retaliation will be forthcoming, devastating and international sanctions may also be part of the retaliatory act. Examples such as Libya's support of the terrorist bombing of a bar in Germany or Pan Am Flight 103's bombing. Libya has been ostracized for its support and so-called tacit approval and support of these terrorist acts. The U.S. and free nations of the world must continuously apply ISR resources to prevent and deter terrorist organizations from being successful. If they are unable to prevent these acts, then the U.S. and her allies must look to potent retaliatory responses against those responsible, including leaders, the terrorists themselves, and any nation that provided support or sanctuary to those involved.

Chapter 3

New Conventional Weapons

To be prepared for war is one of the most effectual means of preserving peace.

George Washington

Since the beginning of time, man has attempted to improve warfare to overcome an enemy. History is full of examples from the large legions of Rome, to mounted guerilla and cavalry tactics of the American Indian, to the advent of rapid fire weapons including the machine gun, to WMD beginning with chemical weapons of WWI, through the advent of biological and nuclear weapons developed in WWII. From the airpower perspective, precision bombing was advocated by Billy Mitchell after WWI, applied in WWII by General Ira Eaker using the Norden Bombsight and azimuth only bombing techniques. Optically Guided Bombs (OGB) were being developed by the British at the end of WWII, but research was stopped at the end of the war. The Vietnam War started a resurgence of research and development of OGB and Laser Guided Bomb (LGB) Precision Guided Munitions (PGM) and continued after the Vietnam War. These guidance packages are accurate in good weather, but are hindered by bad weather and low visibility. New generations of PGMs are now in the inventory using Global Positioning Satellite (GPS) packages that provide near-precision strike in bad and good weather conditions with 10-meter range Circular Error Probable (CEP). OGBs, LGBs,

Joint Direct Attack Munitions (JDAM), and GPS Aided Munitions (GAM) were used very successfully during Operations DESERT STORM and ALLIED FORCE. The Air Force is working to couple GPS and Infrared (IR) packages on weapons in an attempt to achieve 1 – 3-meter CEP precision strike weapons. The U.S. is now on the threshold of new conventional weapons technology which hold hardened and deeply buried targets at risk, as well as smart weapons that loiter over battle lines and target massed hostile forces. These target sets could only be previously destroyed using nuclear weapons. The Libyan Tarhunah chemical complex can now be targeted with conventional weapons with a good degree of confidence that this class of targets can be destroyed. The same can be said of large masses of hostile armor which can now be destroyed using smart submunitions like the Sensor Fuzed Weapon (SFW) coupled with Wind Corrected Munition Dispensers (WCMD).

In 1944, it took 108 B-17s dropping 648 bombs to destroy a point target. In Vietnam, similar targets required 176 bombs. Now, a few PGMs can do the job. Precision munitions also enhance strategic agility. For example, just over three C-5 sorties per day could have supplied every PGM used by the Air Force during the Gulf War.[24] At the beginning of the USAF's Unified Aerospace Power in the New Millennium Conference that HQ USAF/XPX hosted, Major General John L. Barry presented the slide on the next page showing the increased capability of precision guided munitions, both pinpoint bombing and area denial, that graphically portrays current airpower conventional munitions capabilities.

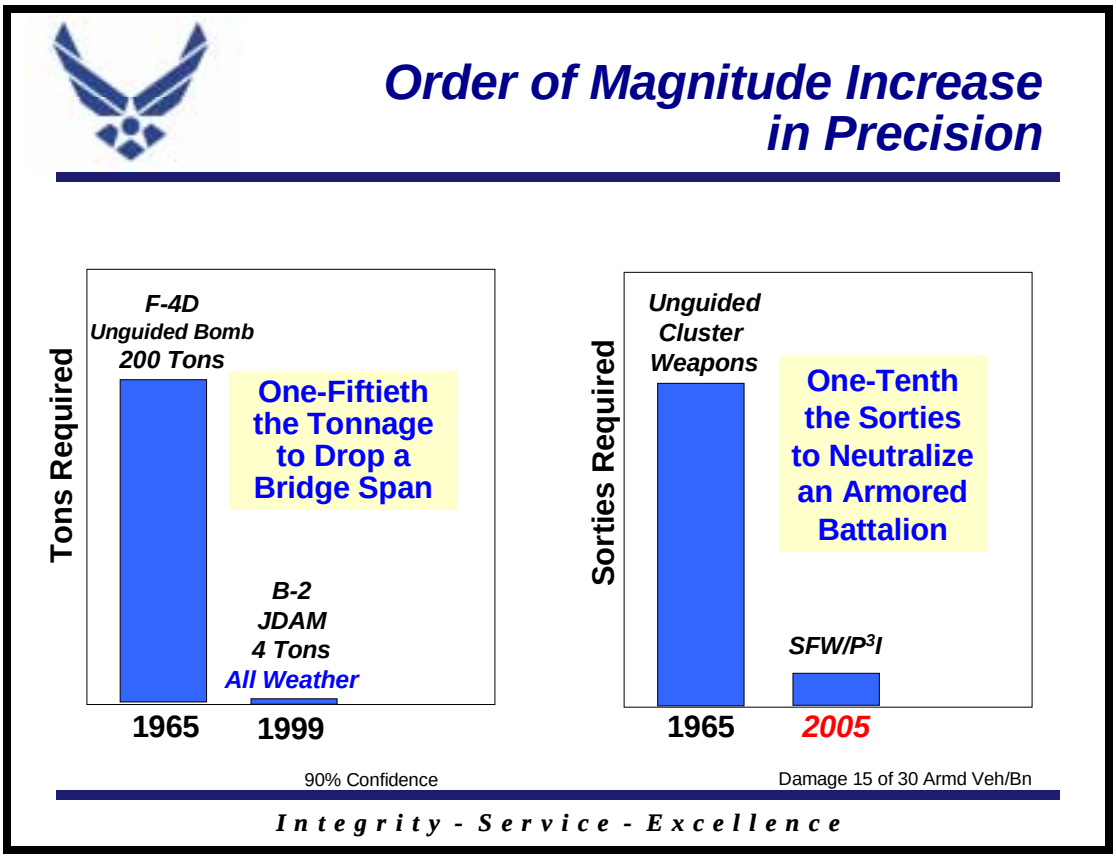

Figure 2. Order of Magnitude Increase in Precision Munitions

Source: Major General John L. Barry's opening presentation at the USAF's Unified Aerospace Power in the New Millennium Conference, February 7, 2001 at Alexandria, VA

Single Warhead Precision Guided Munitions

Joint Direct Attack Munitions and Global Positioning Satellite Aided Munitions

JDAM is a munitions tailkit that produces a weapon with high accuracy, all-weather, autonomous, conventional bombing capability. JDAM upgrades the existing inventory of MK-83 and MK-84 general purpose and BLU-109 and BLU-110 penetrator unitary "dumb" bombs by integrating a guidance package consisting of an inertial navigation system/global positioning system guidance kit. Future product improvements add a terminal seeker to improve accuracy and a new advanced unitary penetrator bomb body.

JDAM can be launched from approximately 15 miles from the target and each can be independently targeted.

Mission plans are loaded to the host aircraft prior to take off and include release envelope, target coordinates and weapon terminal parameters. Once power is applied to the aircraft, the weapon automatically begins its initialization process including automatically down loading targeting data and aligning its INS with the aircraft's system. When released, the bomb's Inertial Navigation System (INS)/GPS takes over and guides the bomb to its target regardless of weather. The Guidance Control Unit (GCU) provides accurate guidance in both GPS-aided INS modes of operation for a 13 meter CEP. If the JDAM is unable to receive GPS signals after launch for any reason, jamming or otherwise, the INS provides rate and acceleration measurements which is translated into a navigation solution for the Desired Mean Point of Impact (DMPI) or target.

The GBU-37 GAM works the same way as the JDAM, but provides a deeply buried, hard target penetration capability with near-precision accuracy using the BLU-113 deep penetration bomb body. The GBU-37 is currently the only all-weather, near-precision "bunker busting " capability available to the United States Air Force.[25]

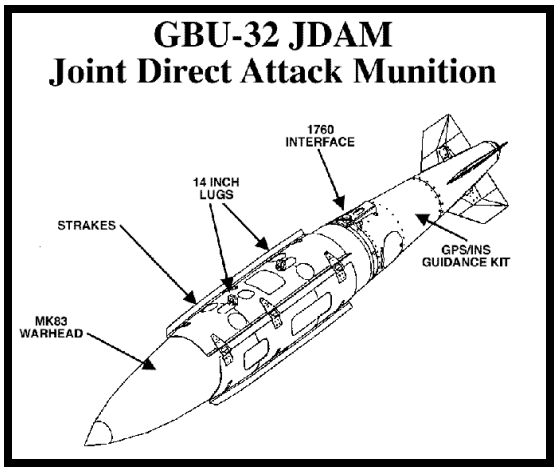

Figure 3. JDAM Fitted to MK-83 "Dumb Bomb" Body

During Operation ALLIED FORCE, 609 GBU-31 V1, 43 GBU-31 V3 and 4 GBU-37 bombs were dropped by B-2 aircraft in all weather conditions and achieved a 98 percent weapons effectiveness rate with little collateral damage. This was the first time JDAM and GAMS were employed against hostile targets proving their effectiveness and lethality.

Figure 4. Pre- and Post-Strike Assessment of a single B-2 JDAM mission During Operation ALLIED FORCE

Source: Unclassified 509th Bomb Wing NWSSG-Combined Brief dated October 22, 1999

Guided Bomb Unit-27

The Guided Bomb Unit (GBU)-27 is a GBU-24, 2,000-pound penetrating warhead, modified for delivery by the F-117 stealth fighter against hard targets. This weapon can penetrate more than six feet of reinforced concrete before detonating its 550 pounds of high explosives. The operator illuminates a target with a laser designator and then the

munition guides to a spot of laser energy reflected from the target. The GBU-27 was used in Operation DESERT STORM and, according to the Air Force, hit 70 percent of its targets. The USAF is currently upgrading the GBU-27 weapons system to become the Enhanced Guided Bomb Unit (EGBU)-27 by adding GPS and INS packages to the weapon's IR guidance package to increase its accuracy and provide it an all-weather capability.[26]

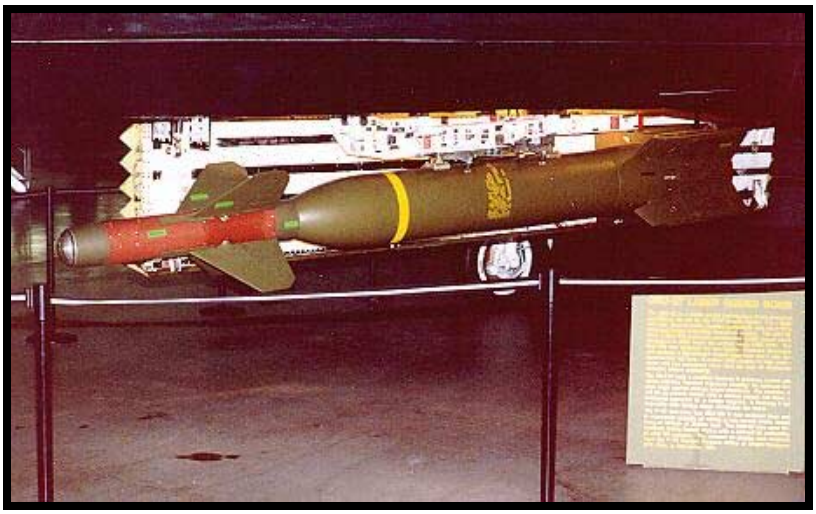

Figure 5. GBU-27 Laser Guided Bomb

Guided Bomb Unit-28

The GBU-28 is a special weapon developed for penetrating hardened Iraqi command centers located deep underground. The GBU-28 is a 5,000-pound laser-guided conventional munition that uses a 4,400-pound penetrating warhead. The bombs are modified Army artillery tubes, weigh 4,637 pounds, and contain 630 pounds of high explosives and are fitted with GBU-27 LGB kits, are 14.5 inches in diameter and almost 19 feet long. The operator illuminates a target with a laser designator and then the munition guides to a spot of laser energy reflected from the target. The USAF is enhancing this weapon by coupling the laser guidance package with GPS and INS

packages as incorporated into the JDAM and will be designated as the EGBU-28. This will also provide and all-weather capability and higher accuracy for this weapon against fixed, hard targets.[27]

Figure 6. GBU-28 Laser Guided Bomb

The GBU-28 is the legacy weapon used by the USAF in its Tri-Service concept exploration effort for the Hard and Deeply Buried Target Defeat Capability. The program objective is to develop capabilities to attack heavily defended, protectively hardened, high priority assets essential to an enemy's war fighting ability. An analysis of alternatives determined legacy or modified legacy weapons could hold a majority of a selected target set at risk.[28]

Miniature Munition Capability

The USAF approved a new Small Bomb System (SBS) acquisition strategy that integrates the SBS on the F-22, F-22X, and Joint Strike Fighter (JSF) and also includes combining the SBS and the Low Cost Autonomous Attack System (LOCAAS) efforts into a single program. This new program has been designated Miniature Munition Capability (MMC) and has a planned start date for FY03.

The Small Smart Bomb is a 250 pound weapon that has the same penetration capabilities as a 2000lb BLU-109, but with only 50 pounds of explosive. The INS/GPS guidance in conjunction with differential GPS using all 12 channel receivers, corrections provided by GPS Accuracy Improvement Initiative, and an improved Target Location Error (TLE), it can achieve a 5-8 meter CEP. The submunition, with a smart fuze, has been extensively tested against multi-layered targets by Wright Laboratory under the Hard Target Ordnance Program and Miniature Munitions Technology Program. This weapon is also a potential payload for standoff carrier vehicles such as Tomahawk, Joint Standoff Weapon (JSOW), Joint Air-to-Surface Standoff Missile (JASSM), Conventional ICBM, etc. The goal of the predecessor Miniaturized Munitions Technology Demonstration (MMTD) effort was to produce a 250-pound class munition effective against a majority of hardened targets previously vulnerable only to 2,000 or 5,000-pound class munitions like the GBU-28 Bunker Buster.[29]

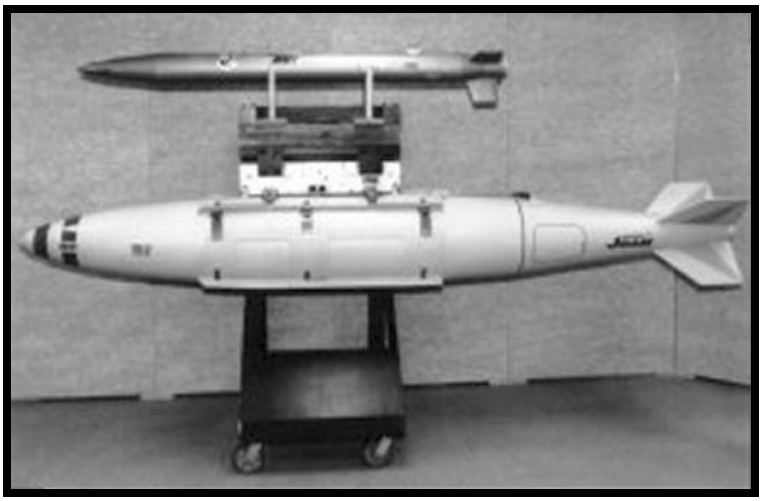

Figure 7. Full-Scale Model of MMTD (Top) & JDAM (Lower)

Source: Federation of American Scientists Military Analysis Network Website, http://www.fas.org/man/dod-101/sys/smart/mmc.htm

Smart Area Denial Weapons

Joint Standoff Weapon

JSOW/AGM-154 is a joint Navy/Air Force program for development of low-cost, air-to-ground weapons which employ a GPS-aided inertial guidance system and a kinematically efficient airframe. The JSOW has an inherent range capability for the Navy, Air Force, and Marine Corps that satisfies the stand-off requirements for attacking interdiction targets from outside enemy point defenses during day, night, and adverse weather conditions. There are currently three JSOW configurations: Air-to-Ground Missile (AGM)-154A, AGM-154B, and AGM-154C. JSOW is an inexpensive, unpowered, and survivable system designed to be carried by a host aircraft and launched to the target area from a Standoff Outside Point Defense. The AGM-154A carries 145 Bomb Live Unit (BLU)-97 bomblets for use against soft and area targets. The AGM-154B, integrates 6 SFW's BLU-108/B submunitions that meets the Air Force and Navy requirement to deliver an anti-armor submunition at stand-off ranges against moving land combat vehicles. The third variant, the AGM-154C, incorporates an affordable seeker, and data link capability, the Fuze Mechanical Unit (FMU)-152 Joint Programmable Fuze (JPF) and a unitary warhead to strike harder/point targets and enhance overall mission effectiveness.[30] These air-to-surface glide weapons provide standoff capabilities from 15 nautical miles (low altitude launch) to 40 nautical miles (high altitude launch).[31]

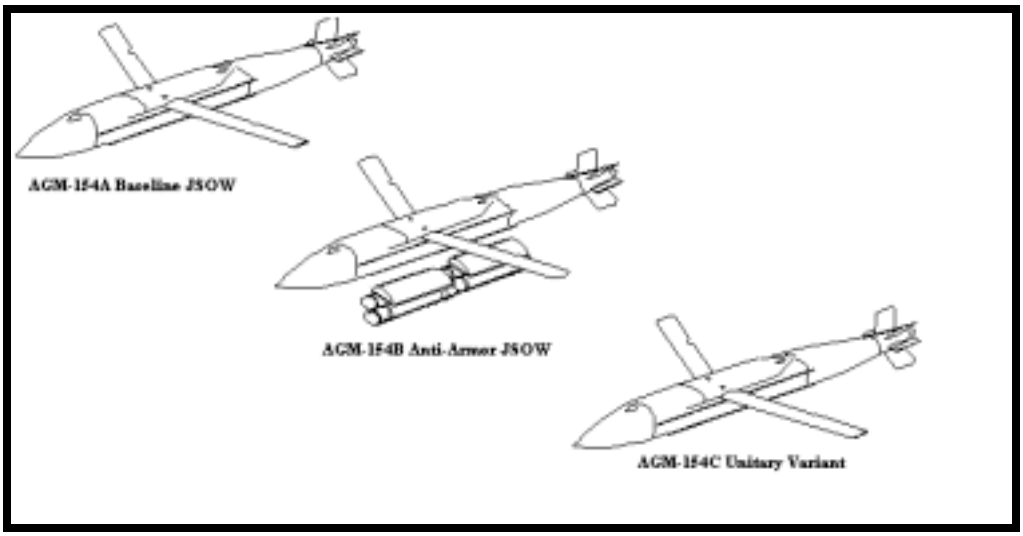

Figure 8. AGM-154 JSOW Variants

Source: Federation of American Scientists Military Analysis Network Website, http://www.fas.org/man/dod-101/sys/smart/agm-154.htm

It must be noted during the last employment of these weapons against Iraqi integrated air defense system around Baghdad, that it appears they were not too successful against radar sites destroying or damaging fewer than half of the radar units targeted according to an unnamed senior defense official.[32]

Sensor Fused Weapon

The Cluster Bomb Unit (CBU)-97/CBU-105 is a 1,000-pound class weapon containing sensor-fused submunitions for attacking armor. The SFW is the centerpiece of the Air Force concept of operations for engaging an adversary's main armored force in the "halt" or "hold" phase of a Major Regional Contingency, in which the USAF would disrupt and stop an attack, providing time for other combatant forces to reinforce to the theater. The Air Force's SFW is a 1,000-pound, unpowered, multiple kill per pass munition. The SFW's tactical munitions dispenser houses 10 BLU-108 submunitions and 40 "hockey puck" shaped skeet infrared sensing projectiles. Each submunition contains

four projectiles, an orientation and stabilization system, a radar altimeter, and a rocket motor. Each projectile contains an explosively formed penetrator warhead and a two-color infrared sensor. If the projectile does not detect a target, it detonates after a fixed elapsed time. Neither the munition dispenser nor the BLU-108 submunitions are guided. However, the projectiles scan a wide area with their infrared sensors searching for targets. The Air Force is also developing a tailkit, termed the Wind Corrected Munitions Dispenser, for the SFW and similar munitions that will provide inertial navigation and allow aircraft to deliver them from high altitudes.[33]

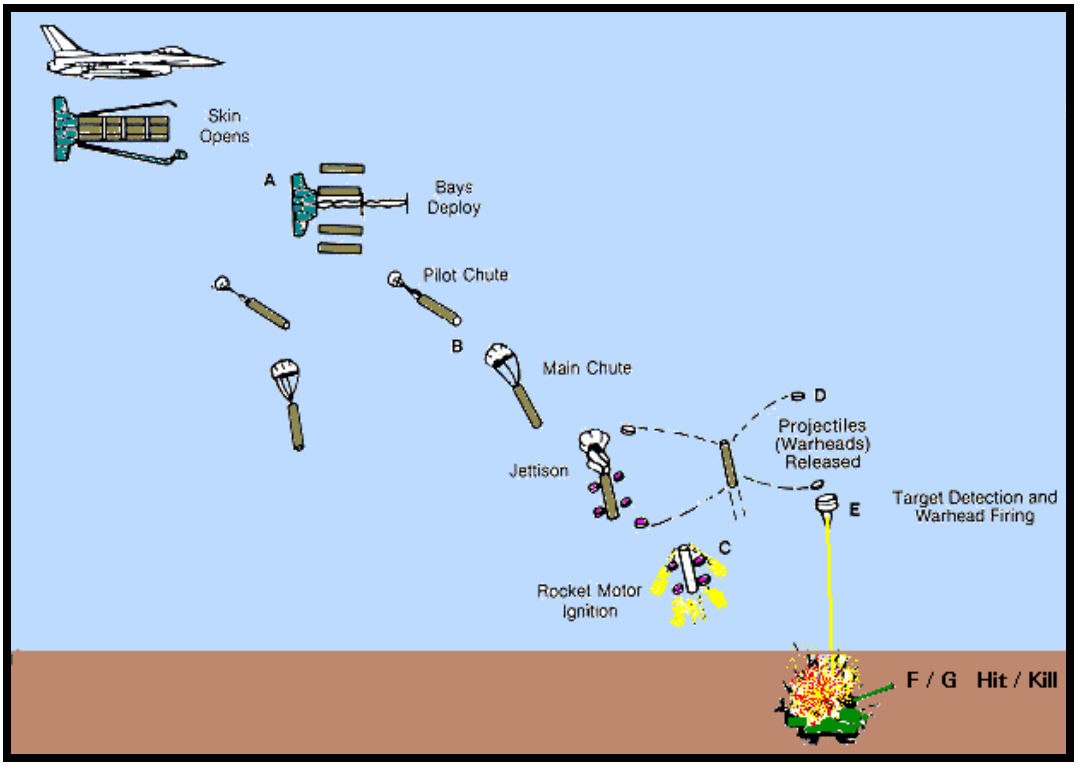

Figure 9. Artist Concept of SFW Attacking Armor

Source: Federation of American Scientists Military Analysis Network Website, http://www.fas.org/man/dod-101/sys/dumb/cbu-97.htm

Figure 10. SFW Being Tested Against Armored Targets

Source: Federation of American Scientists Military Analysis Network Website, http://www.fas.org/man/dod-101/sys/dumb/cbu-97.htm

Agent Defeating Weapons

Operation DESERT STORM highlighted the need for pre-emptive strike capability to disable Chemical and/or Biological (CB) agent munition production facilities and stockpiles. Currently, the United States must resort to conventional warheads as the only means of crippling the enemy CB agent capability. Use of explosives to destroy a CB agent production or storage bunker could result in the release of large quantities of lethal agents, produce significant collateral casualties, and destroy the local environment. The latest national security directives (promoting non-lethal, disabling weapon technology development over current lethal nuclear and conventional weapon systems) direct that new technologies be investigated for disabling CB agent munition production facilities and stockpiles while minimizing collateral casualties.[34]

The Agent Defeating Weapon (ADW) should be effective against hardened chemical targets, soft chemical targets, hardened biological targets, or soft biological targets and ensure widespread physical damage within the target while limiting collateral damage resulting from unintended release of CB agents. The kill mechanisms for achieving the desired results include thermal effects derived from high temperature incendiary materials, low blast fragmenting warheads or submunitions, and neutralizing chemicals. A hybrid warhead payload that employs a combination of the referenced kill mechanisms may be required to achieve program goals, but not include nuclear fissile material or radioisotopes. The ADW will be designed to same external dimensions and closely approximate the mass properties as those for the 2000-lb class BLU-109 warhead and should be compatible with the GBU-24, GBU-27, AGM-130, and GBU-31 guidance kits. The Air Force is currently studying four concepts in an attempt to develop, test and manufacture this class of weapon.[35]

New Fuzes for Bombs

Newer classes of weapons can be effective against various targets only if all components survive and detonate when the weapon will be most effective. Newer fuzes are now placed in the aft section of bomb bodies to ensure survivability until detonation. Prior to Operation DESERT STORM, bomb fuzes were mostly mechanical, and normally attached at the front or tail of the bomb bodies or dual configured with a time delay detonation to ensure penetration of the target. The time delays were variable, but offered few variations in the delay settings. Some of the newer fuzes are discussed below.

Joint Programmable Fuzes

These fuzes are designed to provide planners and weapons officers added flexibility in destroying targets. The FMU-152/B JPF provides an Air Force and Navy Joint Service multi-function fuze for the JDAM employing the MK-84, BLU-109, and MK-83 warheads. The JPF is a high reliability bomb fuze with multiple arm times, instantaneous and multiple (short and long) delay times, hard target survivability, and cockpit programmability. These new fuzes have a 20 year service and 10 year shelf lives. The JPF provides retrofitting compatibility for existing weapons, thereby replacing/supplementing inventory fuzes, and provides the next generation of fuzing capability for hard target, general purpose, and guided bombs.

Hard Target Smart Fuzes

The Hard Target Smart Fuze (HTSF) is an accelerometer-based fuze designed to initiate a penetrator warhead at a predetermined location inside a target to maximize blast effects. The HTSF has four modes of operation: void sensing, hard layer count, depth of burial, and backup timer. The HTSF is compatible with existing fuze wells and should be compatible with the GBU-10, 15, 24, 27, 28, 37, AGM-130, AGM-142, JDAM, JASSM, SBS, and Advanced Unitary Penetrator warheads. The HTSF increases sortie effectiveness through burst point control/optimization and reduced collateral damage. These fuzes can be set to detect voids in buried and hardened targets.

Delivery Systems

Manned Aircraft

The USAF's aircraft inventory is quite capable, but is rapidly aging. According to the Air Force Chief of Staff, General Michael E. Ryan, the average age of the USAF fleet is approximately 25 years.[36] The B-52 bomber was last rolled off the assembly lines in the early 1960s, the last B-1 was built in the 1980s, and the 21 B-2s were built in the late 1980s. Each bomber provides a unique capability for dual use roles, nuclear or conventional, except for the B-1 which is only conventional capable due to the START II treaty. All of the bombers are scheduled to be upgraded to use the new smart conventional weapons or already have the capabilities now. Due to its resounding success in Operation ALLIED FORCE, congress is looking at restarting the B-2 assembly line and building more of the stealth bombers.

Fighters also provide unique capabilities, but none in today's inventory have stealth characteristics save the F-117. The average age for the Air Force fighter fleet is 22 years and will increase to 30 years if the nation does not accelerate new aircraft procurement.[37] The F-15E and F-16 are dual-rolled for tactical nuclear and conventional weapons, and are being upgraded or have the capability for the new smart conventional weapons. The procurement of the F-22 and JSF will provide additional stealth capabilities for the nation's fighter fleet, not just the USAF and be dual rolled capable as the current fighter fleet is. The added advantage of these two new aircraft programs is that of integrated communications, target planning and real-time target updates to the aircraft and its weapons. The F-22 will be the world's most advanced and capable fighter until the JSF

is fielded. The Eurofighter Typhoon will only be conventional weapons capable, thus reducing the ability of NATO allies to respond or aid in a nuclear response mission.[38]

Ballistic Missiles

The U.S. ICBMs are an aging force, with the exception of the Peacekeeper Missile. The majority of the U.S. ICBMs are Minuteman III which date from the 1960s. This system has been kept updated and modernized, but they are of 1960s technology. The airframes, propellant, and engines are slated for replacement in the 2020 timeframe. The U.S. should look at also increasing the hardness and modernization of the silos and the launch control facilities to ensure their survivability as well as quick reconstitution after a launch. The Minuteman III uses a "hot launch" technique in which the engines are fired while it is in the missile silo, thus it is much more costly and time consuming to reconstitute the silo to load another missile. The Peacekeeper uses a "cold launch" system in which the missile is pushed out of the silo by expanding gasses and the engines ignite after it is above ground, thus requiring much less time and resources to reconstitute the silo for a reload. Although the Peacekeeper has been slated for retirement, it should be retained as it is the newest ICBM in the inventory and this system provides for quick reconstitution after launch. Dr. Younger's paper discusses the possibility of placing conventional weapons on ICBMs to reduce collateral damage toward an aggressor.[39] If the U.S. responded to an aggressor using a conventional warhead on an ICBM, this would cause great concern (with a possible nuclear response) to Russia, China and many other nations thinking the U.S. had launched a nuclear strike. Even if the U.S. provided guarantees and warnings to the nuclear states, this would not guarantee that they would not respond with a nuclear response toward the U.S. or that these nations would not tip

off the aggressor the U.S. was targeting. In addition, this would be a great waste of national resources and would not necessarily guarantee the destruction of the intended target since the ICBMs may not be as accurate as the RV reentered the atmosphere. The time it would take to reconfigure an ICBM from a nuclear to conventional warhead must also be taken into consideration. By the time it would take to reconfigure an ICBM, a cruise missile or stealth aircraft strike could already have taken place much earlier.

Dr. Younger also cites that this could be done using SLBMs.[40] Again, the time constraints to reconfigure an SLBM (if it could be done submerged), plus the high costs involved are not worth effort when other assets are readily available. Also, once the launch was detected (many commercial satellite activities and products are now available to the highest bidder), the submarine's location would then be known and could be targeted. Many of the rogue nations discussed earlier now have former Soviet Union submarines capable of targeting a U.S. submarine once its location is known. It is better if the nuclear capabilities on SLBMs and ICBMs remain, rather than attempting to adapt them to a conventional role. Many other conventional platforms are available to perform quick and accurate conventional strikes toward aggressors.

Cruise Missiles

One of the most capable dual purpose platforms without putting crew members at risk that the U.S. has at its disposal are cruise missiles. The current inventory of CALCMs and TLAMs were proven during Operations DESERT STORM, DESERT FOX, DESERT STRIKE, and ALLIED FORCE. The missions were carried out quickly with good accuracy in the destruction of various targets.[41] These weapons threaten highly defended, high risk, and high value targets while reducing the risks to aircrews.

Although these weapons are subsonic, they are hard to hit due to their size and unpredictability of their flight paths. The U.S. is actively upgrading the guidance packages and ranges of these missiles. The extended and long range cruise missile development programs are underway to improve their reach and effectiveness against an adversary.[42] These missiles are dual capable of carrying nuclear or conventional weapons and are much more suitable to hitting targets with conventional warheads than using an ICBM or SLBM. Another cruise missile program that will hold many targets at risk is the AGM-158 JASSM. This missile will provide many capabilities to hold various target sets at risk – from medium hardened targets to relocatable targets like mobile missile systems. This platform may be upgraded to carry LOCAAS smart submunitions to increase its lethality and range.[43]

Figure 11. Joint Air to Surface Standoff Missile

Source: Federation of American Scientists Military Analysis Network Website, http://www.fas.org/man/dod-101/sys/smart/jassm.htm

Targets Sets That Can be Destroyed Using Conventional Weapons

Hardened, Deeply Buried Targets

As previously discussed, hardened, deeply buried targets, like the Libyan Tarhunah Chemical Complex, are definitely placed at risk using nuclear weapons like the B61-11. However, there are limitations placed on how deep nuclear weapons can destroy these types of targets like Cheyenne Mountain. Even a B53 or W53 may not be capable of destroying super hardened targets that are buried and covered by massive sheets of granite. But, many deeply buried targets (excluding those like Cheyenne Mountain) are capable of being destroyed using new emerging conventional weapons. A new penetrator using the BLU-116, 2,000 pound advanced unitary penetrator is being developed. The BLU-116 coupled with the HTSF and GPS guidance packages will provide the military with twice the penetration capability of the current BLU-109. If this advanced unitary penetrator is used on the CALCM, it will provide 2.5 times the capability of the BLU-109 that is currently used with the CALCM. The fins and guidance packages for the BLU-116 are interchangeable with the current BLU-109.[44] Even using the new technology of deep penetrators, intelligence is needed on an intended target's surrounding geology and its construction, to include burst slabs constructed above the target and the target's shape below ground. To ensure destruction of these targets, this intelligence information must be extremely accurate for weapons planners to determine angle of attack of the weapon as well as its angle of impact. These two variables are vitally important in ensuring successful target destruction. During tests using a BLU-113 against a 16 foot reinforced concrete bunker, a 73 degree angle of impact did not destroy the bunker, but when used at a 93 degree angle, the bunker was destroyed. But again, if a burst slab, granite boulders,

or hardened natural rock surrounds the buried structure, the attack may fail to destroy the target.[45] A weapon's angle of attack and impact angle is illustrated below.

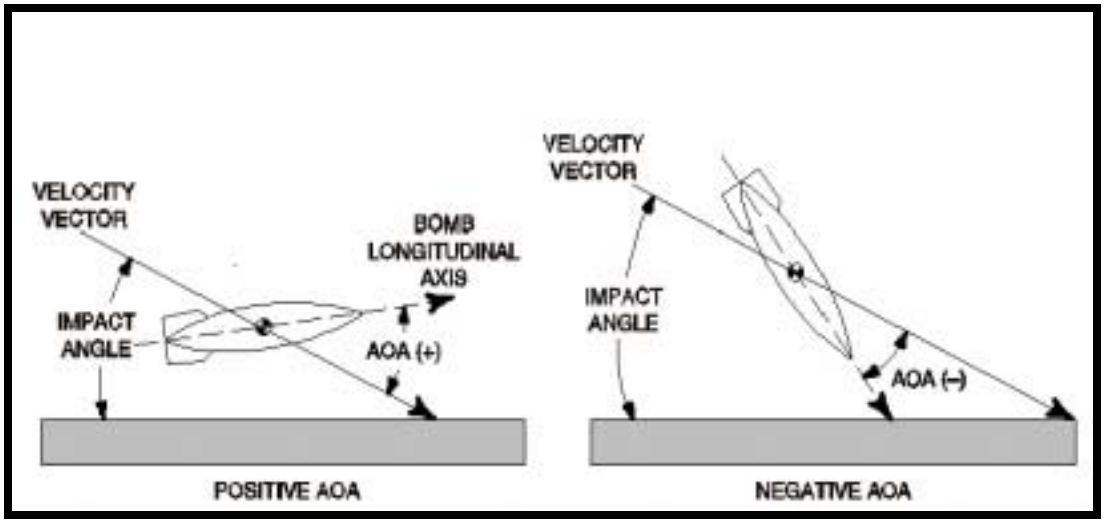

Figure 12. Bomb Angle of Attack and Angle of Impact

Source: Gary C. Thomas, ACS Defense Incorporated, US STRATCOM

Highly accurate and in-depth intelligence of the buried target is imperative to defeat these types of target sets, but U.S. target planners state that it is exceedingly difficult, if not impossible, to obtain this type of hostile buried targets intelligence.[46] It must be noted that even with extremely accurate intelligence, there are limitations on any weapon to destroy superhardened, deeply buried targets. These type of target sets will have to be defeated functionally.

WMD Targets

Nuclear, Biological, and Chemical (NBC) and support/storage areas are beginning to be held at risk using new conventional weapons technology. The USAF and USN are actively pursuing conventional weapons technology to destroy these types of facilities while retaining or destroying the agents within the structure and minimizing collateral damage including fatalities. The USN is working on an Inter-Halogen Oxidizer weapon

while the USAF is pursuing a solid fuel-air explosive using aluminum particles. Both of these weapons use an incineration technique to defeat and destroy the CB agents within the blast area.[47]

Mobile Targets

Armor, mobile missile platforms, terrorist camps and personnel are easily targeted using current technology if accurate and timely intelligence can be obtained. Newer technology as defined above for area denial weapons are within easy grasp. New Low Cost Autonomous Attack System (LOCAAS) weapons will be able to loiter over an area and autonomously target and destroy specific targets. Once again, planners and targeteers must rely on highly accurate and timely intelligence to precisely define the threat, target, and location.

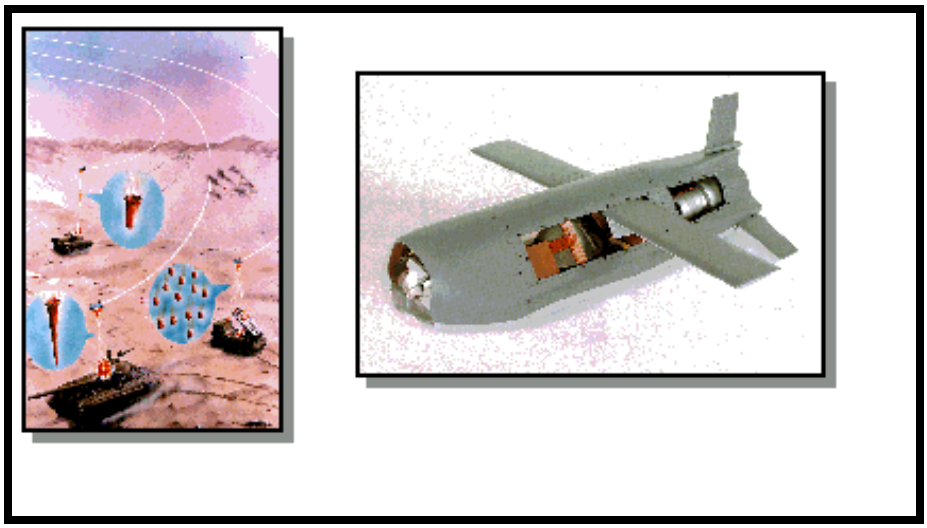

Figure 13. Low Cost Autonomous Attack System

Source: Federation of American Scientists Military Analysis Network Website, http://www.fas.org/man/dod-101/sys/smart/docs/locaas_Industry_Day/sld001.htm

Chapter 4

Recommendations/Conclusions

> *If the enemy is to be coerced, you must put him in a situation that is even more unpleasant than the sacrifice you call on him to make. The hardships of the situation must not be merely transient - at least not in appearance. Otherwise, the enemy would not give in, but would wait for things to improve.*
>
> Karl von Clausewitz

As U.S. leaders and strategists review and restructure American military forces to the level needed to maintain the peace and security of the nation, its vital interests, and allies, they must first review and define the nation's vital interests and national strategy. Once this has been done, then the Department of Defense can define its military strategy to meet the national interests and source the weapons and equipment needed to meet the nation's security requirements. The simultaneous two major regional conflict concept began only as a planning document, and was never intended to be a national military strategy. However, congressional and administration officials began using the document as the basis for a national strategy and began sourcing to it as a way to reduce the national budget. This placed the U.S. in an extremely precarious position which could have cost many American lives if North Korea and either Iran or Iraq, or both, would have allied with one another to start simultaneous conflicts. The U.S. leadership, congressional and the executive administration, must decide now whether the U.S. remains the world's only superpower capable of global reach and global power across the entire spectrum of

warfare and military assistance or relegate itself to be a regional power. If the past military budget trends continue, the U.S. military will decline and it will become a regional power while retaining only a nuclear global capability. If the U.S. is to remain the sole superpower, then its military conventional and nuclear forces must be adequately funded and manned to retain its global status.

First and foremost, the U.S. must have an integrated missile defense system for its forces in theaters around the world as well protection of its own borders and its allies. It must retain the freedom to operate in space and be fully capable of protecting all of its space assets. National intelligence is vitally important and the nation must exploit all intelligence capabilities, especially HUMINT, and not be only locked into Cold War intelligence gathering mindset. The Soviet Union is gone, the more viable and immediate threats are evolving from rogue states and non-state actors, however, the U.S. cannot ignore Russia and China. According to US STRATCOM planners, the U.S. has exceeded intelligence gathering abilities to define underground target sets (geology, type of construction, shape, and design of potential adversaries facilities) for targeteers to adequately define mission parameters with confidence of destruction.[48]

The U.S. must continue aggressive research and development of military and intelligence capabilities and must never hesitate to deter an actor who threatens the U.S., her vital interests or allies. U.S. military strategy must adapt to effectively use new technological advances to counter the emerging threats. It is also extremely important that the U.S. military have the global airlift and sealift capabilities comparable with its direct combat forces in order to sustain combat actions if called upon.

National Missile Defense

The U.S. must never be placed into a position of being either coerced or threatened by an aggressor who intends to use WMD. President Bush and his cabinet have effectively explained the reasons for missile defenses. NATO allies are just now beginning to understand this need, for if the U.S. is ever blackmailed of not intervening militarily, these nations will also be held at risk. Russia, more than any other nation, understands the need for an adequate defense of a nation's borders and, in the author's view, will acquiesce on the U.S. NMD stance. U.S. forward deployed forces must also be kept safe and free from missile attacks, just as its forces have been free from aerial attack since WWII. Missile defense must not just thwart ballistic missile attacks, but the "poor man's" Scud or cruise missile attacks as well. NMD coupled with Theater High Altitude Area Defense (THAAD) system should be the U.S. number one priority for development.

Nuclear Posture Review 2001

The NPR is scheduled for the Fall of 2001 and much work must be accomplished in the diplomatic and military arenas now. Russia must be actively engaged to reduce its nuclear stockpile, especially its non-strategic stockpile. This will be a tradeoff as the U.S. can now afford to reduce it tactical nuclear weapon stockpile as well due to advances in conventional weaponry. As shown above, many hardened and other target sets previously held at risk with nuclear weapons can now be targeted with conventional weapons. When the NPR is convened, conventional and nuclear target planners must work on coordinated plans at what missions can now be picked up using conventional weapons versus nuclear. The U.S. must not totally give up the tactical or limited nuclear

option, but these options can be reduced given conventional weapon technology advances. Tactical nuclear weapons must not be given up unilaterally, especially any that may be forward deployed, but only reduced in number if Russia will do so in kind. The bottom line is that U.S. STRATCOM is now combining some of its staff and planners to use effects based targeting using both nuclear and conventional weaponry.[49] U.S. STRATCOM is now beginning to emerge from the bi-polar Cold War planning and is now planning for the emerging threats to the U.S. with its new combined nuclear and conventional targeting cell. The U.S. military strategists must continue to capitalize on effects based bombing to ensure the defeat of an aggressor – the nation can no longer afford to only focus on targets, but what are the desired effects of prosecuting hostilities. The following chart greatly illustrates this point.

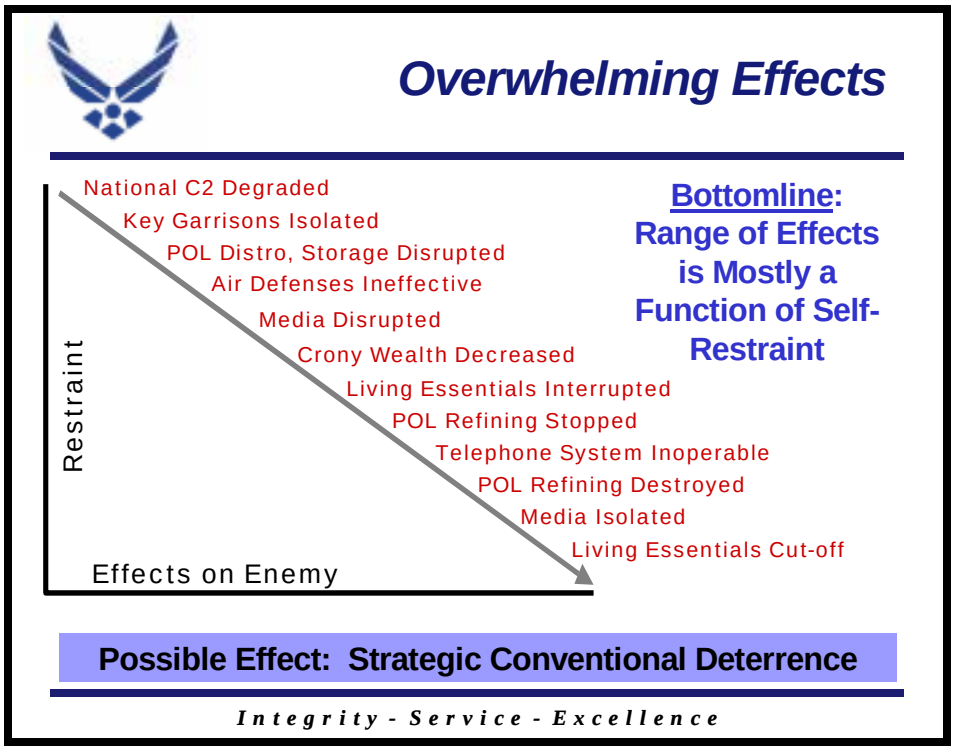

Figure 14. Effects-Based Bombing

Source: Major General John L. Barry's opening presentation at the USAF's Unified Aerospace Power in the New Millennium Conference, February 7, 2001 at Alexandria, VA

Continued Development of Conventional Weapons

Research and development of smart conventional weapons must continue. When these weapons enter the inventory, after much testing and validation, the U.S. military must not rely on one type of guidance package, weapons delivery platform, or propulsion system. These weapons must be thought of as we now think of the U.S. Triad. If one system is defeated, others must be capable of taking its place and providing the same effects based targeting as the U.S. places in the Triad. The U.S. is in the forefront of research and development of non-lethal weaponry as well. The new "active denial technology" that the media recently coined as the "pain beam" can be very useful in the many peacekeeping and peace enforcement missions the U.S. military is now engaged in. However, this same weapon can also be adapted to battlefield use. Another emerging weapon is the aircraft based laser weapon that is being tested on a Boeing 747 test bed, known as the YAL-1A. This laser is only the start of placing this type of weapon on aircraft or eventually into space to prevent missile attacks. The laser itself is simply one part of a potential NMD system, as the other portions must have launch detection and trajectory tracking. Directed energy weapons research and development must continue aggressively with the intention to field these types of weapons. These weapons will cause the nature of warfare to change on the magnitude that nuclear weapons did when they were developed. Researchers are just now beginning to comprehend the capabilities of these weapons, but warfare strategy to employ these weapons must be debated and envisioned now.

Figure 15. USAF YAL-1A Airborne Laser Aircraft

Evolution of the Nuclear Stockpile

The U.S. nuclear stockpile should be updated, but this will mean that the U.S. unilateral testing ban must be lifted. Although the U.S. stockpile is reliable, it is aging and it was designed to counter a massive Soviet attack on the U.S. or NATO. Again, the current stockpile structure and strategy must be thoroughly reviewed before and during the upcoming NPR. Dr. Younger believes that a new generation of nuclear weapons could be developed that would lower the nuclear yield that our current weapons now have. This would result in lower collateral damage and casualties if the weapons were more accurate and designed for digging out super hardened structures. There are many nuclear activists that believe if the nuclear yield is lower, military leaders will be more inclined to use them. Any employment of nuclear weapons must be directed by the National Command Authority (NCA) and requires explicit presidential authorization, the physical safeguards prevent any one person from authorizing detonation. There will continue to be a large threshold to cross before any use of nuclear weapons will be authorized or employed by U.S. leaders.

Many, approximately 75 percent of current hardened targets, can be destroyed using conventional weapons and the new advanced unitary penetrator, BLU-116, will provide even more capability against these target sets. A new strategy of using conventional and new generation of nuclear weapons with U.S. STRATCOM performing the strategic targeting will hold an adversary from starting a general war with the U.S. After Operation DESERT STORM, some Iraqi generals stated that Saddam Hussein did not employ WMD due to clear communicated assurances that the U.S. would respond with anything within the U.S. arsenal in retaliation.[50] Current and future U.S. leadership must continue to clearly communicate the same assurances and be willing to employ the full U.S. arsenal against any aggressor who threatens the nation with WMD.

The U.S. must retain nuclear weapons on ICBM and SLBM systems and not relegate them for delivering a "conventional message" to aggressors. The next NPR is extremely vital for the U.S. security and must not be taken lightly. Another major problem with reducing the U.S. nuclear stockpile, is that secure nuclear storage areas for the weapons and nuclear components are full. The U.S. must look at how to reduce or destroy the nuclear components as it reduces the amount of weapons. One way may be to launch space vehicles with unneeded nuclear components and waste toward the sun. This may be expensive, but the U.S. and other nations are running out of room to secure and store these components on earth without damaging the environment or natural resources or prevent proliferation of these components.

Intelligence Resources

The U.S. greatly lacks intelligence gathering and has focused its efforts primarily on the former Soviet bloc nations and China. It is now imperative that the U.S. intelligence

agencies combine its activities, collection and interpretation efforts to counter the emerging threats of the 21st century. U.S. intelligence bureaucracies compete for the same intelligence and reconnaissance data many times and cause hindrances for other agencies who may have a greater need at a specific time. These intelligence organizations can be over 400 percent more effective if they are combined and appropriately structured. Research and development of space based resources, such as a seismic or magnetic reading satellites, must be fielded quickly. The "Buck Rogers" technology that was only available from Hollywood films in the 1950s and 1960s is now on the nation's doorstep. The U.S. must actively pursue all aspects of intelligence gathering concepts if it is to prevent another Khobar Towers or USS Cole incident.

Engagement

The U.S. cannot be an isolationist nation. The world has evolved into a global community and there is no nation that is not touched or affected by another. The U.S. is the recognized world leader and must aggressively seek out Russia and China to prevent nuclear weapons and missile technology proliferation to other nations or organizations. Cruise missile, bomb making and WMD technology is readily available to virtually anyone who has access to the Internet. It is now easy to adapt a cruise missile from targeting shipping to targeting land assets and vice versa.

The U.S. must also actively work to decrease the amount of nuclear weapons in the world's arsenal, not eliminate them totally as they cannot be disinvented. The U.S. is already aiding Russia with money and resources to reduce their stockpiles, but Russia has the world's largest and active nuclear weapon production capability and can easily

increase its current production rate. The U.S. has not produced nuclear weapons in many years, but still relies on its current stockpile that has been stagnant in size since the 1980s.

Conclusion

This paper in no way completely covers this topic adequately, but was designed to spur thinking for the 21st century planners for the nation's security in light of the upcoming NPR. The United States was founded to provide freedom and security for its citizens. This nation has never been coerced by threats or intimidation, but actively and aggressively challenged those who attempted these types of hostile acts. If the nation's leaders do not adequately source the resources to effectively maintain its freedoms to operate autonomously and cooperatively with friendly nations, then it will be only a matter of time before its very survivability is threatened. The USAF evolved from the U.S. Army as the nature of warfare changed. For the time being, the USAF is capable of performing of ensuring the freedom of space, but before the century is over, it may be in the best interests of the nation to create a separate space force.

The world has evolved from approximately four nations that had space capabilities in the 1960s. Almost every nation in the world today relies on free access and use of space assets each day. The freedom of space access is as vital as the need for petroleum products and free access to markets in sustaining global economies and nations. New crises are developing over potable water access, population growth and expansion, petroleum access, and intertwining economies. The world is growing more complicated day by day with the demands placed on its limited resources and access to those resources. The U.S. must remain the world's leader or be willing to give up some of these access rights and protection of the innocent and friendly nations from aggressors.

The author does not advocate the unilateral or total reduction of tactical nuclear weapons or the limited nuclear option, only that the opportunity is at hand to reduce the levels of the stockpiles if Russia is willing to do the same. The U.S. currently has the means, conventional and nuclear, to protect her interests and allies as well as projecting her forces and power globally.

> *It is inherent in our deterrent posture to have a full spectrum of "combat options" available to the war planner or incident responder. The nuclear threshold is just too high to be broken and it will only be broken in the event of total global warfare. Regional conflicts are the "new" wars to be fought, other wars are just too costly in terms of manpower and resources.*
>
> Roger W. Hansen
> Colonel, USAF Retired

Glossary

ABM	Anti-Ballistic Missile
BLU	Bomb Live Unit
C^3	Command, Control, and Communications
CALCM	Conventional Air-Launched Cruise Missile
CB	Chemical and/or Biological
CEP	Circular Error Probable
DMPI	Designated Mean Point of Impact. Target and weapons officers designate coordinates on target for the exact impact point for the aircrews to aim at
DoD	Department of Defense
DoE	Department of Energy
EGBU	Enhanced Guided Bomb Unit
GAM	GPS Aided Munition. Northrop Grumman Corporation developed this interim precision guidance system, using GPS and INS, in concert with the USAF for a guidance package to be fitted on the MK-84, BLU-109 and BLU-113 bomb bodies as interim precision strike weapons. The BLU-113 uses the GAM tailkit, but MK-84 and BLU-109 uses the interchangeable Boeing JDAM kit.
GATS	GPS Aided Targeting System
GBU	Guided Bomb Unit

GBU-27	Laser guided bomb package coupled with the BLU-109 2,000 pound bomb body designed for use against hardened structures. Features a high-strength forged steel case and a new delayed-action tail fuze. It carries 550 pounds of high explosives and can penetrate more than six feet of reinforced concrete before exploding.
GBU-28	BLU-113, 5,000 pound, hard target penetrating bomb body coupled with a laser guidance package. Used against deeply buried hardened targets such as command and control facilities and normally referred to as a "Bunker Buster" like the GBU-37
GBU-31 V1	MK-84, 2,000 pound bomb body, using a JDAM guidance package. Normally used against "soft targets"
GBU-31 V3	BLU-109, 2,000 pound penetrating bomb body, using a JDAM guidance package. Used against "hardened targets" such as above ground hardened aircraft shelters
GBU-37	BLU-113, 5,000 pound, hard target penetrating bomb body coupled with a GPS Aided Munition guidance package. Used against deeply buried hardened targets such as command and control facilities and also referred to as a "Bunker Buster" like the GBU-28
GPS	Global Positioning Satellite
HTSF	Hard Target Smart Fuze
ICBM	Intercontinental Ballistic Missile
IIR	Imaging Infrared
IR	Infrared
IRBM	Intermediate Range Ballistic Missile
ISR	Intelligence, Surveillance, and Reconnaissance
JASSM	Joint Air-to-Surface Standoff Missile
JDAM	Joint Direct Attack Munition. A "dumb bomb" body, MK-84 or BLU-109, coupled with a GPS guidance and fin section giving it a near-precision (13 meter CEP) capability. Developed and manufactured by Boeing.

JPF	Joint Programmable Fuze
LGB	Laser Guided Bomb
LOCAAS	Low Cost Autonomous Attack System
MMTD	Miniaturized Munitions Technology Demonstration
MIRV	Multiple-Independently Targeted Reentry Vehicles
MRV	Multiple Reentry Vehicles
RV	Re-entry Vehicle
NATO	North Atlantic Treaty Organization
NBC	Nuclear, Biological and Chemical weapons
NUWEP	Nuclear Weapons Employment Policy
NPR	Nuclear Posture Review
OGB	Optically Guided Bomb. Research and development was started by the British at the end of WWII, but halted at the conclusion of the war. It began in earnest again in the late 1950s
SBS	Small Bomb System. An acquisition program to mate smart munitions capability to a 250 lb conventional munition and give it a penetrating capability of a 2,000 lb JDAM
SDI	Strategic Defense Initiative
SIOP	Single Integrated Operations Plan
SLBM	Submarine Launched Ballistic Missile
SSBN	Fleet Ballistic Missile Submarine
THAAD	Theater High Altitude Area Defense
TLAM	Tomahawk Land-Attack Missile
TLE	Target Location Error

Triad	The three complementary weapons systems--ballistic missile submarines, land based intercontinental ballistic missiles and long-range bombers--upon which US strategic nuclear deterrence rests
WMD	Weapons of Mass Destruction normally defined as nuclear, biological and chemical munitions

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[3] Ibid., pp. 1.7-1.8.

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