The Transformation of Strategic-Strike Operations

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EXECUTIVE SUMMARY

The US military is currently investing billions of dollars annually in developing and deploying a broad range of new precision-guided and electronic-strike weapons. These weapons are revolutionizing the way military organizations are thinking about future conflict. Perhaps nowhere are the potential implications of these weapons more significant than in the case of nuclear forces and strategic-strike operations. For the last forty years, the US strategic deterrent has centered on a triad of intercontinental bombers and land- and sea-based ballistic missile forces. A strong case can be made that the United States should take steps to create a new strategic-strike triad, relying on its precision- and electronic-strike capabilities to form two of the three legs, with a smaller residual nuclear force comprising the third leg.

Given the current geopolitical landscape and the US lead in developing and deploying nonnuclear precision- and electronic-strategic-strike weapons, it would appear that the residual nuclear force of the new strategic triad might comprise somewhere between 2,000–3,000 warheads. Indeed, given the considerable opportunity costs of maintaining nuclear forces above this level, the United States should strongly consider reducing its current nuclear forces to these levels for strategic reasons, irrespective of current arms control negotiations.

Periods characterized by dramatic surges in technologies, such as those underwriting the development of precision- and electronic-strike weapons, have often led in the past to equally dramatic changes in the conduct of war. These weapons seem likely to blur what was once a relatively clear distinction between nuclear and conventional weapons. The US military may soon be capable of conducting, against certain types of strategic targets, nonnuclear strategic-strike operations at levels of military effectiveness approaching those of nuclear strikes. As the congressionally appointed National Defense Panel noted in 1997, "Advancing military technologies that merge the capabilities of information systems with precision-guided weaponry and real-time targeting and other new weapons systems may provide a supplement or alternative to the nuclear arsenals of the Cold War." Thus, although nuclear weapons have dominated discussions of strategic-strike operations since their appearance at the end of World War II, the United States may increasingly be able to rely on both precision-guided munitions (PGMs) and electronic means of attack to effect a significant displacement of nuclear weapons in these operations.

This condition will emerge, in part because, as the world continues its transition away from industrial-based economies and toward information-based ones, there will likely be a corresponding shift in the principal sources of military, economic and political power of states. The character of the strategic target base will necessarily change to reflect these developments. The strategic bombardment depicted in old World War II newsreels showed massive bomber raids on steel plants and fire storms ignited by incendiary bombs. Cold War era films projected horrific images of the aftermath of atomic explosions. Future strategic strikes may instead find militaries, in a growing number of instances, being able to employ well-placed conventional precision and electronic strikes discretely directed against critical elements, or nodes, of an adversary's center of gravity.

Given the changes in the strategic target base and the emerging precision- and electronic-strike capabilities, it would seem increasingly appropriate for the United States to consider fielding a new type of strategic triad. Residual nuclear forces would be relied upon to address those strategic targets that cannot otherwise be disabled or destroyed by nonnuclear means and to serve as the ultimate guarantor of deterrence by holding an adversary's society at risk. Assuming that the United States does not want to rely on a pure countervalue targeting strategy, it would appear that residual nuclear forces in the new strategic triad could comprise somewhere between 1,500–3,000 warheads.

Transitioning toward an increased reliance on nonnuclear strategic-strike capabilities could offer several major advantages over today's high reliance on nuclear weapons. For one, strategic deterrence—including extended deterrence—might be enhanced, since the threat of employing the nonnuclear elements of the new triad would probably be seen as more credible than the threat of employing nuclear weapons. Moreover, while there is unquestionably some deterrence value in not foreswearing the possibility of nuclear retaliation, potential adversaries would be far more likely to believe, and thus be deterred by, a US threat to respond to a nonnuclear provocation with conventional and/or electronic strikes.

There may also be benefits to having a nonnuclear strategic-strike capability in the event that deterrence of nuclear use fails. At that point, the relevant question would then become how best to restore deterrence. The basic requirement for restoring deterrence is straightforward—the United States, together with like-minded countries, would have to demonstrate to the world community that the penalty for nuclear use is exceedingly high. Nuclear retaliation, of course, would serve this purpose rather well, but it would also further undermine the tradition of non-use. That is to say, a nuclear response to nuclear use may in fact work at cross-purposes with the objective of re-establishing nuclear deterrence. In contrast, nonnuclear strategic strikes may, in some instances, be capable of making nuclear renegades pay dearly for their errant behavior without undercutting the presumption of non-use.

Furthermore, by adding a rung on the escalation ladder between conventional theater war and general nuclear war, a nonnuclear strategic-strike capability could provide US political leaders with a very valuable commodity during a period of crisis: flexibility. This rung could also act as a firebreak that might prove helpful in preventing an escalation to nuclear war.

Since a nonnuclear strategic strike would be far more discriminating than a comparable nuclear strike, it would also offer benefits in war termination. The effects of the former are likely to be far more easily reversed than those of the latter, and the prospect of a relatively rapid return to normalcy may substantially strengthen an adversary's incentives to cease hostilities.

Given the funding shortfalls of the current defense program, maintaining a larger than necessary nuclear force posture incurs substantial opportunity costs that impede efforts to improve US military capabilities in areas where real shortfalls exist (i.e., in creating a different kind of strategic-strike capability). Reducing the current US strategic nuclear forces to Strategic Arms Reduction Treaty (START) II levels (i.e., 3,500 warheads) would save some $6 billion over the next seven years. Moving below START II levels to 2,000 warheads could save as much as an additional $2 billion per year through 2010. Last, but not least, by transforming its strategic-

strike forces in a way that devalues nuclear weapons, the United States may encourage other advanced military organizations to do the same.

To be sure, there are several potential disadvantages associated with this new type of strategic triad, which warrant careful study. First of all, conventional precision-strike and electronic-strike weapons will, for the foreseeable future, be incapable of reliably disabling all, or even a majority of, strategic targets. While technologies are currently being developed to enhance conventional bomb damage assessment (BDA), obtaining accurate information about the results of precision strikes will probably continue to be difficult. Generating dependable BDA for electronic strikes is, and will likely remain, even more problematic. In many cases, successful electronic strikes will not generate any directly observable signatures. By contrast, assuming they detonate properly, nuclear weapons leave comparatively little doubt about whether the target has been disabled. Moreover, would-be adversaries can also be expected to explore ways for offsetting nonnuclear, strategic-strike systems (e.g., by constructing deep underground facilities, hardening other targets, etc.).

There is also the danger that the development of an effective nonnuclear strategic-strike capability by the United States—because it would appear to be much more useable than a nuclear-strike capability—could *increase* the incentives for potential adversaries to acquire at least a small nuclear arsenal for deterrence purposes. Their objective would be to have their homeland, or at least some portion of strategic targets within it, accorded sanctuary status. This may be especially true with less-developed countries, which may view the acquisition of a substantial conventional strategic-strike capability as well beyond their means and view nuclear weapons as a relatively cheap (albeit primitive) counter. Moreover, nuclear weapons will also likely prove irreplaceable to major powers as instruments of assured destruction of the enemy homeland. In fact, nuclear weapons seem likely to exert a strong and enduring influence on warfare, casting a long shadow over humankind even after the emerging military revolution matures in the early decades of this century.

Amassing an inventory of conventional PGMs and, to a lesser degree, electronic-strike systems sufficient for two major regional contingencies, as well as for strategic deterrence and warfighting, could also be a rather expensive undertaking. To a certain extent, these weapons would be developed and produced for other operations, but the *additional* cost associated with creating a strategic reserve that could supplant part of the existing nuclear arsenal would be substantial. Nuclear weapons are simply more efficient than conventional PGMs, particularly with respect to destroying large area targets such as ports, airfields, storage depots, industrial complexes, and other high-value military installations. As a result, depending on the proportion of such targets in the future strategic target set, it would probably be necessary to procure hundreds of PGMs for every nuclear warhead replaced.

Another possible downside to reduced reliance on nuclear weapons is that it could lower the entry barrier to nuclear superpower status. For instance, it would not be in the US interest to lower its nuclear arsenal unilaterally to the point that relatively minor nuclear powers could easily become de facto nuclear peers. Nor would it be prudent to so outpace Russia in reducing the US nuclear inventory that a disarming nuclear first strike against US strategic forces (both conventional and nuclear) becomes even a remote possibility.

Finally, there is the chance that this type of strategic triad could make both conventional and nuclear conflict *more* likely by making the consequences of engaging in strategic warfare appear more palatable. It can be argued that the willingness of nuclear-armed states to engage in conventional conflicts with each other has been throttled in the past by the prospect, however slight, that escalatory pressures or misperceptions might trigger a nuclear war. By reducing the perceived risk of nuclear conflict by interposing the option of nonnuclear strategic warfare, it is possible that conventional wars may actually become more frequent. As a result, the risks of inadvertent escalation to nuclear weapon employment might increase.

In the final analysis, this paper raises more questions than it provides answers. But asking the right questions is the key to laying the foundation for a comprehensive strategic assessment of future strategic-strike operations and their implications for US security. Among other things, any strategic-strike net assessment must account for the highly dynamic nature that characterizes military competitions during periods of military revolution, such as we find ourselves at present. For example, we do not know with high confidence those states that will comprise the major competitors in strategic-strike capabilities. Nor do we know what paths these competitors will take in terms of developing the various capabilities comprising the new strategic triad or the policies and doctrines that will govern the use of these capabilities. Yet strategic planners must make decisions today that will determine the character and effectiveness of US strategic-strike forces in a post-transformation regime. In its own way, this represents a challenge as demanding for strategists as that posed by the last major transformation in strategic-strike capabilities a half century ago.

I. INTRODUCTION

OVERVIEW

The US military is currently investing billions of dollars annually in developing and deploying a broad range of new conventional and electronic-strike weapon systems. These weapons, which benefit from a combination of increased range, speed, precision, and overall lethality, are made possible by dramatic advances in information and information-related technologies. They are revolutionizing the way military organizations are thinking about future conflict. Perhaps nowhere are the implications of these weapons more significant than in the case of nuclear forces and strategy. Although nuclear weapons have dominated discussions of strategic strike since their appearance at the end of World War II, the United States may increasingly be able to effect a significant displacement of nuclear weaponry by relying on both PGMs and electronic means of attack.

STRATEGIC STRIKE: A BRIEF PRIMER

Strategic-strike operations may be defined as those oriented on the principal sources of an enemy's military, economic or political power. Strategic-strike operations have, as their primary focus, the goal of disabling the enemy's center of gravity. Here the center of gravity is defined as those military, economic or political assets that, when denied to the enemy, will result in the loss of his ability or will to offer further resistance to friendly forces in achieving their strategic objectives.

To achieve decisive results, strategic-strike operations must surmount several major challenges. First, one must be able to identify what constitutes the enemy's center of gravity. Identifying with precision those assets that, once disabled, will induce an enemy to yield, is a demanding proposition.[1] This problem is further compounded by the dynamic quality that an adversary's center of gravity can exhibit over time. Second, one must possess the means for attacking the enemy's center of gravity. The longer it takes to execute the strategic-strike campaign, the greater the time, and thus the opportunity, for the enemy to take offsetting measures. In short, an effective strategic-strike campaign can be highly dependent upon its prompt execution.[2] Third, conducting effective strategic-strike operations also requires measuring the effects of the strikes themselves. Determining the effectiveness of strategic-strike campaigns has never been easy. Moreover, as technology has progressed and societies have become more complex and integrated, the consequences of disabling individual targets or clusters (sets) of targets have

[1] Absent the large-scale use of nuclear weapons, the prompt disabling of an enemy's center of gravity confronts the problem of time and resources. Given limited non-nuclear strategic-strike resources (e.g., strike platforms, precision weaponry, command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) elements), it becomes important to identify which targets will yield strategic effects when they are neutralized, and which will not. This has proven a daunting task in previous strategic bombing campaigns. The problem is further compounded by the ability of the enemy to defend against strategic strikes and to alter his strategic target base, as well as by political limitations placed on the conduct of strategic-strike operations and technical limitations on friendly strategic-strike systems.

[2] See, for example, Herman Gilster, *The Air War in Southeast Asia: Case Studies of Selected Campaigns* (Maxwell Air Force Base, AL: Air University Press, October 1993), pp. 117–36.

arguably become more difficult to measure. Typically one must explore the second- and third-order effects of strategic strikes to get a sense of how they are influencing an enemy's ability to wage war.[3]

The challenges inherent in conducting an effective strategic-strike campaign centered on air power clearly manifested themselves in World War II. Despite the optimistic predictions of enthusiasts such as Guilio Douhet and Billy Mitchell, who argued in the 1920s that air power could quickly produce decisive results in future conflicts through strategic-strike operations, the strategic bombing campaigns conducted by the American, British and German air forces were neither short nor decisive.[4] The US Army Air Force and Royal Air Force Combined Bomber Offensive against Germany was the subject of extensive study and analysis in the Strategic Bombing Survey following the war. The survey provided grist for the spirited debates that followed over the merits, and shortcomings, of strategic-strike operations.[5]

However, before the debate over the prospective effectiveness of conventional strategic-strike operations could be fully joined, it was displaced by the introduction of nuclear weapons in July 1945. Once nuclear weapons entered the US arsenal in significant numbers, the enormous increase in destructive power they offered made it possible to contemplate a strategic-strike campaign that could be executed far more rapidly—and efficiently—than with conventional weapons. The capability to disable promptly an enemy's center of gravity (indeed, to destroy the enemy's society as a functioning entity) was substantially enhanced with the introduction of thermonuclear (fusion) weapons in the early 1950s, and with the development of long-range ballistic missiles, which further compressed the time needed to execute nuclear strategic strikes.

The prospective military utility, in a strategic sense (i.e., employing such strikes to achieve political ends), of this capability diminished substantially once the Soviet Union acquired significant numbers of nuclear weapons.[6] For a time the United States adopted a declaratory

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[3] For a discussion of the importance—and difficulty—of choosing analytic measures and determining the effectiveness of strategic-strike operations, see James G. Roche and Barry D. Watts, "Choosing Analytic Measures," *The Journal of Strategic Studies* (June 1991). See also Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey: Summary Report* (Washington, DC: Government Printing Office (GPO), 1993), pp. 55–117.

[4] See, for example, David MacIsaac, "Voices from the Central Blue: Air Power Theorists," *Makers of Modern Strategy*, ed. Peter Paret (Princeton, NJ: Princeton University Press, 1986), pp. 624–47; and Williamson Murray, "Strategic Bombing: The British, American, and German Experiences," in *Military Innovation in the Interwar Period*, ed. Williamson Murray and Allan R. Millett (Cambridge, UK: Cambridge University Press, 1996), pp. 96–143.

[5] See J. Kenneth Galbraith, Burton H. Klein, et al., *The Effects of Strategic Bombing on the German War Economy* (Washington, DC: GPO, October 1945); Bernard Brodie, *Strategy in the Missile Age* (Princeton, NJ: Princeton University Press, 1959); Major General Haywood S. Hansell, Jr., *The Air Plan That Defeated Hitler* (Atlanta, GA: Higgins-MacArthur/Lingino and Porter, 1972); Major General Haywood S. Hansell, Jr., *Strategic Air War Against Japan* (Washington, DC: GPO, 1980); and Burton H. Klein, *Germany's Economic Preparations for War* (Cambridge, MA: Harvard University Press, 1959).

[6] For example, President Eisenhower, when faced with the prospect of executing a nuclear strike against China during his presidency, declared to the Joint Chiefs of Staff, "There is no victory except in our imaginations." Cited in John Newhouse, *War and Peace in the Nuclear Age* (New York: Vintage Books, 1988), p. 106. Strategist Bernard Brodie observed, "But even if you shoot first, you will probably die. This [weapon] brings us a long way from the subtleties of a Clauswitz, a Jomini, or a Mahan. It brings us, in short, to the end of strategy as we know it." Bernard Brodie, "Strategy Hits a Dead End," *Harper's*, October 1955, pp. 33–37. In the years immediately following the Soviet Union's acquisition of nuclear weapons, the United States explored the option of waging preventative war against the Soviet Union or of adopting a pre-emptive strategic strike. But these options were ruled out. With respect

defense posture of massive retaliation that relied heavily on the early employment of nuclear weapons in the event of aggression.[7] In practice, however, the United States chose to employ conventional forces when aggression threatened in the Taiwan Strait, Lebanon and Indochina. Fears that a crisis or war involving Soviet client states could escalate into a superpower

confrontation saw strategic-bombing campaigns throughout the Cold War era (e.g., in the Korean and Vietnam Wars) restricted to employing conventional munitions only.[8]

To be sure, strategic nuclear-strike concepts of operation changed over time as enhancements were made in these forces, such as improved missile accuracy and the MIRVing of their warheads.[9] Changes in nuclear strategic-strike posture (e.g., the development of limited nuclear options under Defense Secretary James Schlesinger) reflected the changing composition and force levels of the US and Soviet nuclear forces.[10] These changes notwithstanding, nuclear strategic-strike operations continued to be viewed almost exclusively by political leaders as a deterrent to the threat of an enemy *nuclear* strategic strike.[11] In summary, despite the nuclear weapon-ballistic missile revolution, nonnuclear strategic-strike operations both survived and continued their evolutionary development that began with the initial strategic bombing campaigns of World War II. Surviving as well was the debate over the relative effectiveness of nonnuclear strategic-strike operations.[12]

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to the latter posture, President Eisenhower observed that such an attack "would be not only against our traditions, but it would appear to be impossible unless Congress would meet in a highly secret session and vote a declaration of war which would be implemented before the session was terminated. It would be impossible that any such thing would occur." *The Eisenhower Diaries*, ed. Robert E. Ferrell (New York: W. W. Norton, 1981), pp. 311–12. Cited in David A. Rosenberg, "A Smoking, Radiating Ruin in Two Hours," *International Security*, Winter 1981/82, p. 15. See Russell D. Buhite and Wm. Christopher Hamel, "War for Peace: The Question of an American Preventive War against the Soviet Union, 1945–1955," *Diplomatic History*, vol. 14, Summer 1990, pp. 367–84.

[7] For an account of the massive retaliation defense posture, see John Foster Dulles, "Policy for Security and Peace," *Foreign Affairs*, April 1954.

[8] Throughout the Cold War though, non-nuclear strategic air campaigns, like those against North Korea and North Vietnam, were treated as aberrations from the nuclear standard. Consequently, they had little effect on the development of doctrine, strategy, planning, or capabilities.

[9] MIRV stands for multiple independently targeted re-entry vehicle. A MIRVed missile contains a rocket-powered vehicle or bus that carries several warheads. After the boost phase of the missile is complete, the bus can make small, carefully controlled changes in its velocity, dispensing a warhead toward a distinct target with each shift in velocity. As a result, a single missile can be used to strike targets scattered within an elliptical footprint on the ground. See Ashton Carter et al, *Managing Nuclear Operations* (Washington, DC: The Brookings Institution, 1987), pp. 381–82.

[10] James R. Schlesinger, *Annual Defense Report, FY 1975* (Washington, DC: GPO, March 1974), pp. 32–42. See also James R. Schlesinger, "Flexible Strategic Options and Deterrence," Press Conference of the US Secretary of Defense, January 10, 1974, at the National Press Club, Washington, DC, in *Nuclear Strategy, Arms Control, and the Future*, ed. P. Edward Haley and Jack Merritt (Boulder, CO: Westview Press, 1988), pp. 101–07.

[11] For example, President John F. Kennedy declared that, in the event of nuclear war, "The fruits of victory would only be ashes in our mouths." http://library.thinkquest.org/11046/sitroom/jfk_speech.html. President Ronald W. Reagan was equally direct when he stated that "A nuclear war cannot be won, and must never be fought." Ronald W. Reagan, Radio Address, April 17, 1982, cited in Jay M. Shafritz, *Words on War* (New York: Prentice Hall, 1990), p. 295.

[12] For a discussion of the strategic-strike campaigns conducted during the Korean and Vietnam Wars, see Mark Clodfelter, *The Limits of Air Power* (New York: The Free Press, 1989).

II. THE CHANGING STRATEGIC LANDSCAPE

Treating Russia's nuclear forces as a baseline for US force requirements had considerable merit during the Cold War, but it is of less relevance today when considering the more complex array of strategic threats we confront. The principal, indeed overarching, danger the United States faced from nuclear weapons during the Cold War—a large-scale, nuclear-missile attack on the US homeland—has receded dramatically with the collapse of Russia's hostile communist regime, the elimination of nuclear forces in the former non-Russian Soviet republics and the steady reduction (and erosion) of Russian nuclear forces.

Recognizing the reduced threat to America following the collapse of the Soviet Union, the Clinton Administration's policy, dubbed "Lead but Hedge," called for the United States to take the lead in moving toward lower nuclear force levels, while also hedging against the instabilities and uncertainties of today's security environment. However, in practice, reductions in US strategic nuclear forces have been tightly linked to progress on arms reduction negotiations with Russia. The 1994 Nuclear Posture Review (NPR), for instance, strongly recommended that US nuclear forces should not be reduced below the START I force level of 6,000 warheads unless and until START II was ratified.[13] Similarly, ever since 1995, the US Congress has included language in each annual National Defense Authorization Act (NDAA) to preclude unilateral US reductions in nuclear forces below START I levels until START II "enters into force."[14]

As the Cold War arms control process slowly labors forward, the strategic landscape around it is changing dramatically. The proliferation of ballistic and cruise missiles, potentially armed with weapons of mass destruction (WMD), poses a growing strategic threat to the US homeland and American interests abroad. In addition, the on-going information revolution promises to usher in a military revolution that will have a substantial impact on the conduct of strategic-strike operations. Given current trends in the range, accuracy and lethality of conventional weapons and the emergence of new electronic-strike capabilities, it will likely become possible to hold at risk strategic target sets that have heretofore been considered solely within the nuclear domain. As the congressionally appointed National Defense Panel noted in 1997, "Advancing military technologies that merge the capabilities of information systems with precision-guided weaponry

[13] In discussing the Nuclear Posture Review of 1994, for example, the 1995 Defense Annual Report states, "Once START II has been ratified, further negotiated reductions can be considered." See William J. Perry, *Annual Report to the President and the Congress* (Washington, DC: US GPO, 1995), p. 85. See also Elaine Grossman, "Strategic Command Chief Sees Russian Nuclear Forces Degrading by 2005," *Inside the Pentagon*, August 29, 1996, p. 5.

[14] For example, in the *National Defense Authorization Act for Fiscal Year 2000*, Congress instructed that "funds available to the Department of Defense may not be obligated or expended for retiring or dismantling, or for preparing to retire or dismantle any of the following strategic nuclear delivery systems below the specified levels: 76 B-52H bomber aircraft, 18 ballistic missile submarines, 500 Minuteman III intercontinental ballistic missiles, and 50 Peacekeeper intercontinental ballistic missiles" until the START II Treaty "enters into force." Unlike preceding years, the NDAA for fiscal year 2000 did include an exemption that allowed for a unilateral reduction of four Trident ballistic missile submarines if the President certified to Congress that a series of conditions had been met. See Section 1501 of the *National Defense Authorization Act for Fiscal Year 2000*.

and real-time targeting and other new weapons systems may provide a supplement or alternative to the nuclear arsenals of the Cold War."[15]

THE COLLAPSE OF START II?

In January 1993, President Yeltsin and President George H. Bush signed the original START II agreement, which obligates the United States and Russia to reduce their nuclear force levels to no more than 3,500 deployed warheads. The US Senate subsequently ratified it on January 26, 1996. At their March 1997 meeting in Helsinki, President Clinton and President Yeltsin reached several new side agreements, including the following:

- An extension of the deadline for elimination of strategic nuclear-delivery vehicles under START II from January 1, 2003 to December 31, 2007;

- A commitment to remove the reentry vehicles or otherwise deactivate all strategic nuclear delivery systems slated for elimination under the START II Treaty by December 31, 2003;

- An understanding that, given Russian ratification of START II, a START III agreement would be achieved and enter into force "well in advance" of the deactivation deadline noted above; and

- An overall limit between 2,000 and 2,500 deployed strategic warheads as the basis for a future START III Treaty.[16]

These agreements were formalized in a Joint Agreed Statement and a Protocol to the treaty in September 1997. Ratification of the treaty and these new agreements by the Russian Duma, the lower house of parliament, was subsequently derailed by international events that soured relations with Washington: the US bombing of Iraq in December 1998 and American military intervention in Kosovo in the spring of 1999. Finally, on April 14, 2000, newly elected Russian President Vladimir Putin managed to obtain ratification of the treaty as one of his first legislative initiatives in office.[17] The Duma attached an important proviso, however, that conditions Russia's willingness to implement the treaty to US ratification of the Joint Agreed Statement, the Protocol, and an Anti-Ballistic Missile (ABM) Treaty demarcation agreement. The Protocol, also signed in September 1997, established performance parameters for delineating between allowable theater missile defenses (TMD) and strategic missile defenses banned under the 1972 ABM Treaty.

It is very unlikely, however, that the US Senate will ratify any of these new agreements in the near future. The ABM demarcation agreement, in particular, has already drawn the ire of many

[15] Report of the National Defense Panel, *Transforming Defense—National Security in the 21st Century*, p. 51; available on-line at www.dtic.mil/ndp.

[16] "Fact Sheet—START II Protocol and Letters of Early Deactivation," released by Arms Control and Disarmament Agency (ACDA), September 26, 1997.

[17] Michael Gordon, "Putin Wins Vote in Parliament on Treaty to Cut Nuclear Arms," *New York Times*, April 15, 2000, p. 1.

influential senators because it would create a barrier to future TMD and national missile defense (NMD) systems.[18] Given that the Bush Administration has made the fielding of a NMD system one of its top priorities, there is a reasonably good chance that the US government will move forward with development and deployment of a system over the coming decade. Initially, the system will probably be configured to protect US territory against accidental missile launches or small missile attacks from rogue states such as North Korea and Iran. While the United States hopes to negotiate amendments to the ABM Treaty to allow such a system, Russia seems unlikely to acquiesce. Moscow considers the ABM Treaty to be a cornerstone of strategic stability for several reasons, not the least of which is that a limited US NMD system would dilute the deterrent value of its dwindling nuclear forces. Countless Russian officials have warned, often with near apocalyptic rhetoric, that unilateral US abrogation of the ABM Treaty would be highly destabilizing and lead to an arms race of unprecedented proportions.[19]

Although Russia clearly does not have the resources to engage in an arms race with the United States, it may opt to abrogate START II—especially the prohibition against multiple-warhead intercontinental ballistic missiles (ICBMs)—if the United States deploys an NMD system. Indeed, Moscow has upped the ante by threatening to withdraw from *all* conventional and strategic arms control and nonproliferation agreements if the United States goes ahead with its NMD plans. In an appearance before parliament, President Putin asserted that if the United States abrogates the ABM Treaty, "we will withdraw not only from the START II Treaty, but from the whole systems of treaties on the limitation and control of strategic *and* conventional weapons."[20]

Putting aside the fact that Russia has already violated the Conventional Forces in Europe (CFE) Treaty as a result of its force deployments to Chechnya, these threats are best viewed as diplomatic posturing aimed at extracting concessions from the United States. Despite an exceedingly poor hand, Moscow appears to be playing its few cards very skillfully in hopes that some type of grand bargain might be reached. For example, the Kremlin might accede, albeit reluctantly, to ABM Treaty modifications permitting each side to deploy a very limited NMD system in exchange for US acceptance of a 1,500 warhead ceiling under START III.[21] Ostensibly, Russian willingness to enter into such an agreement would appear counterintuitive in that deeper reductions in nuclear force levels would aggravate, rather than alleviate, concerns over NMD negating its nuclear deterrent. However, if Moscow believes that Russia's nuclear

[18] Steven Mufson, "Protocols May Draw Senate Fire, Spur Bid for Broader Arms Pact," *Washington Post*, April 15, 2000, p. 17. It should be noted that many experts in the field maintain that the ABM Treaty no longer remains in effect following the collapse of the Soviet Union. See Robert F. Turner, *The ABM Treaty and the Senate: Issues of International and Constitutional Law*, Occasional Paper Series (Charlottesville, VA: Center for National Security Law, University of Virginia, 1999); and R. James Woolsey, "What ABM Treaty?" *Washington Post*, August 15, 2000, p. 23.

[19] See, for example, John Diamond, "Russia Says Missiles May Revive Cold War," *Chicago Tribune*, May 3, 2000, p 1; Alice Lagnado, "Russia Angry Over Revived 'Star Wars' Plan," *London Times*, August 18, 1999, p. 1; and David Hoffman, "Moscow Proposes Extensive Arms Cuts," *Washington Post*, August 29, 1999, p. 29.

[20] Emphasis added. Michael Gordon, "Putin Wins Vote in Parliament on Treaty to Cut Nuclear Arms," p 1. See also Bill Gertz, "U.S. Missile Plan Hits Roadblock," *Washington Times*, October 22, 1999, p 1.

[21] General Vladimir Yakovlev, commander of Russia's Strategic Rocket Forces, has recently advocated precisely this type of linkage, stating that, "A country that wishes to increase one of the components will have to cut the other." Sharon LaFraniere, "Putin Suggests Deeper Bilateral Weapons Cuts," *Washington Post*, November 14, 2000, p. 37.

forces will inevitably fall below 1,500 deployable warheads owing to the bloc obsolescence of its existing forces and inadequately funded modernization programs, then obligating the United States to reduce its forces to an equivalent level would be a strategic coup.

Nevertheless, given the reluctance of the US Senate to ratify the Joint Agreed Statement and the Protocol, vehement opposition in the US Senate to the ABM demarcation agreement, and passionate opposition in the Russian Duma to ABM Treaty modifications, the prospects for START II officially entering into force anytime soon appear dim.

BREAKING THE COLD WAR MINDSET

The prospective collapse of the START II Treaty should not preclude the United States from *unilaterally* reducing its nuclear forces. The size of Russia's nuclear arsenal will almost certainly decline over the coming decade regardless of whether the treaty enters into force. Barring a dramatic turnaround in its economy, Russian nuclear forces will drop well below START II levels within ten years. As a recent report by the Natural Resources Defense Council (NRDC) concluded:

> [E]ven if mandated dismantlement and destruction lags behind the pace of the United States (and that is not clear), Russian nuclear forces will continue to decline due to a lack of financing and the natural effects of aging, exacerbated by the interruption of the cycle of Cold War modernization.[22]

While less than a decade ago Russia had four strategic weapon modernization programs underway, it can now barely afford to keep the Topol-M (SS-27) production line going at an anemic rate of less than 10 missiles per year.[23] According to Russian estimates, 75 percent of the plants that manufactured strategic missile components during the Soviet era are now located outside of the Russian Federation and most of them closed their doors years ago.[24] In addition, a series of test failures led to the cancellation in 1997 of a new, solid-fueled, submarine-launched ballistic missile (SLBM) to replace the aging SS-N-20, which incidentally, has already been extended well beyond its planned service life. A new SLBM program based on the design of the SS-27 was started in 1998, but has made little progress. Of the 62 ballistic missile submarines (SSBNs) that were operational in 1990, only about 20 are even nominally functional at present.[25] Except for a few Blackjack bombers that have been recently pieced together with parts originally produced in the 1980s, Russia's bomber program is at a standstill.

In short, nuclear delivery vehicles of all types are reaching and, in many cases, exceeding limits on their estimated service lives faster than the Russian military can replace them. According to

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[22] William M. Arkin, Robert S. Norris and Joshua Handler, *Taking Stock: Worldwide Nuclear Deployments, 1998* (Washington, DC: Natural Resources Defense Council, March 1998), pp. 11–12.

[23] In fact, only six additional Topol-M ICBMs became operational in 2000. See Nikolai Novichkov, "Russia Prolongs Life of ICBMs to Save Money," Jane's Defence Weekly, October 11, 2000, p. 5; and David Hoffman, "Shift Seen in Russian Nuclear Policy," *Washington Post*, December 27, 2000, p. 20

[24] Steven Zaloga, "RVSN Revival Rests with the Topol-M," *Jane's Intelligence Review*, April 1998, p. 5.

[25] See Steve Zaloga, "Russia's Strategic Forces Stumble," *Jane's Intelligence Review*, October 2000, p. 13.

officials in Russia's Strategic Missile Force (SMF), over 60 percent of its ICBMs are already beyond their guaranteed service life.[26] So even assuming that the Kremlin makes good on its threat to abrogate START II if the US Senate fails to ratify the Helsinki agreements, Russia would be hard pressed to maintain more than about 2,500 warheads in the field by 2010. Given current trends, Table 1 presents a worst-case scenario for the United States with respect to a build up in Russian nuclear forces over the next decade.

Table 1: Estimate of Russian Nuclear Force Levels circa 2010

Sources: Robert Norris and William Arkin, "Russian Nuclear Forces 2000" and Khripunov, "Last Leg of the Triad," pp. 70–71, 58–64; Carnegie Non-Proliferation Project, "The Incredible Shrinking Russian Nuclear Force," *Carnegie Endowment for International Peace—Issue Brief*, June 1, 2000.

[a] Russia has deployed 20 SS-27s over the last two years. While Russian authorities have claimed that the production rate for the SS-27 could be as high as 30–40 missiles per year, this is clearly unrealistic given forecasted funding levels. The figure in this chart reflects an annual production rate of 10 missiles.

[b] As a heavy ICBM, the SS-24 is supposed to be eliminated under START II. The SS-24 and SS-25 have been in service since 1987 and 1985, respectively. The service lives of both missiles have already been extended once. To still be in service in 2010, these missiles would have to go through an extensive service life extension program, which would be both costly and time consuming. This chart assumes that roughly half of the current inventory could be refurbished and kept operational.

Given the requisite resources, Russia could prolong the service life of the SS-24 multiple warhead missiles banned under START II, as well as the relatively modern SS-25 Sickle ICBM. Both the SS-25 and new SS-27 could be fitted to carry at least four MIRVs, instead of the START II-compliant single warhead. However, Russian threats to keep the SS-18 heavy ICBM in service lack credibility. The SS-18 was built in the Ukraine in the 1980s and nearly all of plants involved in its production have long since ceased operations. The service life of the SS-18 was already extended once in the 1990s from about 10–15 years to over 20 years. According to most estimates, it is simply impractical for the SS-18 to remain operational beyond 2006.[27]

Many analysts believe it is unlikely that Russia will be able to field over 1,000 warheads by the close of this decade. A recent NRDC report concluded, for example, that unless there is a large increase in defense spending, by 2008 the number of Russian operational strategic warheads is

[26] Until recently the SMF was known as Russia's Strategic Rocket Forces (SRF). Ibid., p. 12; and Igor Khripunov, "Last Leg of the Triad," *The Bulletin of the Atomic Scientists*, July/August 2000, p. 62. See also Nikolai Novichkov, "Russia Must Ratify START II or Lose Parity with USA," *Jane's Defence Weekly*, December 9, 1998, p. 12.

[27] Nikolai Sokov, "Rocket Union?", *Jane's Defence Weekly*, February 10, 1999, p. 25.

likely to fall to some 800–1,500 warheads.[28] Some analysts put the estimate as low as 500 warheads by the end of 2012.[29]

During the late summer of 2000, a public dispute broke out between General Anatoly Kvashnin, the chief of the Armed Forces' General Staff, and Marshal Igor Sergeyev, the current defense minister and former head of Russia's Strategic Rocket Forces, over the relative allocation of resources between Russia's conventional and nuclear forces.[30] General Kvashnin has called for deep reductions in Russia's nuclear forces to free up badly needed funding for procurement of conventional arms, military pay raises and weapons research and development (R&D). Reports vary on the details, but apparently, General Kvashnin recommended that Russia's inventory of ICBMs be slashed to 500 by 2006, and to 100–150 by 2010.[31] President Putin reportedly favors the basic thrust of Kvashnin's proposal.[32]

Thus, notwithstanding the stalled entry into force of the START II agreement and concerns over US deployment of a limited NMD system, Russia will probably have a strong interest in negotiating much deeper reductions in nuclear forces over the coming decade. It is not at all surprising that Moscow is already pushing for an aggregate warhead ceiling of 1,500 for START III, substantially lower than the 2,000–2,500 limit agreed to just three years ago in Helsinki. Even at the 1,500 level, however, it will still be difficult for Russia to maintain a safe, reliable nuclear force given current economic constraints.

In addition to the rapid erosion of Russia's nuclear arsenal, its conventional forces and its economic base—principal targets for a prospective US nuclear retaliatory strike—have also deteriorated precipitously in recent years. In the case of the Russian armed forces, this deterioration has approached a near collapse, to the point where the dispirited and disaffected Russian military is seen by some as a greater danger to its own government than to any foreign state. R&D funding and new system procurement are practically nil. Wages for the troops are in arrears. Morale is low and desertion rates are high. Crime and corruption within the military are

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[28] Arkin, Norris and Handler, *Taking Stock: Worldwide Nuclear Deployments*, p. 12. See also David Hoffman, "Downsizing a Mighty Arsenal," *The Washington Post*, March 16, 1998, p. 1; and "Russia's Atomic Force 'Ready,' Premier Says," *The Boston Globe*, February 22, 1997, p. 8.

[29] See testimony by Bruce Blair before the Subcommittee on Strategic Forces, US Senate Armed Services Committee, March 31, 1998. According to Russia's former First Deputy Prime Minister Yuri Maslyukov, the decay of Russia's nuclear stockpile is even more acute. He concluded that in ten years, "the most we can hope for is several hundred nuclear charges." Joseph F. Pilat and Terence T. Taylor, "Amid Russia's Turmoil, Finishing START Remains a Priority," *Wall Street Journal* (Europe Edition), October 15, 1998.

[30] The SMF consumes the smallest portion of Russia's overall defense budget, estimated at 10 to 15 percent but accounts for about half of the weapons acquisition and R&D budget. See Nikolai Sokov, "A Conflict of Strategic Interests," *Jane's Defence Weekly*, August 2, 2000, n.p.; and David Sands, "Submarine Disaster Fodder for Arms Debate," *Washington Times*, August 15, 2000, p. 20.

[31] Zaloga, "Russia's Strategic Forces Stumble," p. 14. Some reports call for a minimal deterrent force of 150 to 400 ICBMs by 2003. See Giles Whittel, "Military Chiefs Feud Over Missile Cuts," *London Times*, July 17, 2000, p. 1; Fred Weir, "Putin Tries Big Shift in Military Strategy," *Christian Science Monitor*, August 2, 2000, p. 1; and Nikolai Sokov, "A Conflict of Strategic Interests," n.p. See also David Hoffman, "Putin Faces Split over Future of Russian Military," *Washington Post*, November 30, 2000.

[32] Throughout late July and early August of 2000, President Putin either fired or forced into retirement several of Defense Minister Sergeyev's allies. This purge may reflect Putin's support of Kvashnin's plan to funnel resources away from the SMF and toward the conventional armed forces.

rampant.[33] Large-scale anti-terrorist interventions in Chechnya in 1994 and again in 1999 exacerbated this situation, exacting a serious toll on what remains of Russia's armed forces. Weapon and supply stockpiles have been largely consumed, and funds are not available to replenish them.[34]

Herein lies the tension between those arguing for deep cuts in Russia's nuclear forces to liberate funding for the conventional forces and those opposing this course of action. The latter argue that to compensate for the degradation of Russia's conventional military strength, it must place greater reliance on its nuclear forces. In a sense, the aging nuclear forces are the last remaining jewel in the tarnished Soviet crown of military might, which Russia has inherited. As an official signal of this shift in strategy, Moscow abandoned its long-standing no-first use declaratory policy in 1993 and promulgated a new National Security Concept in 1997 that explicitly states that nuclear weapons could be used in response to a conventional conflict.

> Russia retains the right to use all available forces and means, including nuclear weapons, if armed aggression launched against it threatens the very existence of the Russian Federation as an independent, sovereign state. . . . The main task of the Armed Forces of the Russian Federation is to ensure nuclear deterrence, which is *to prevent both a nuclear and a conventional large-scale or regional war*, and also to meet its allied commitments. To accomplish this task, the Russian Federation should have a potential of nuclear forces which can guarantee that planned damage will be caused to any aggressor state or coalition of states.[35]

In sum, the Russian military must square the circle of buttressing its conventional forces through cuts in its nuclear forces, while still ensuring nuclear force levels are not so low as to threaten deterrence. This is the source of much of their anxiety over the proposed American national missile defense system.

THE EMERGING WMD THREAT

As the Russian threat has receded, concerns over the proliferation of weapons of mass destruction, especially to hostile rogue states such as Iran, Iraq and North Korea, have risen in prominence.[36] Emerging WMD threats promise to reshape the strategic landscape, presenting the

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[33] See, for example, Dr. Mark Galeotti, "Russia's Criminal Army," *Jane's Intelligence Review*, June 1999, pp. 8–10; and Dr. Mark Galeotti, "The Russian Army in Chechnya," *Jane's Intelligence Review*, December 1999, pp. 8–9.

[34] According to some reports, the war in Chechnya has consumed up to 85 percent of the army's stockpile of arms, supplies and equipment. See Robyn Dixon, "Putin Pledges to Reform Russia's Military Forces," *Los Angeles Times*, August 12, 2000, p. 1.

[35] Emphasis added. Edward Warner, assistant secretary of defense (strategy and threat reduction), Statement before the Subcommittee on Strategic Forces, Senate Armed Services Committee, Hearing on Nuclear Deterrence, March 31, 1998. See also Deborah Yarsike Ball, "How Safe is Russia's Nuclear Arsenal?", *Jane's Intelligence Review*, December 1999, p. 11; and Dr. Mark Galeotti, "Russian Army 2000?", *Jane's Intelligence Review*, January 2000, p. 17. This policy shift was also published in the October 1999 Russian Military Doctrine statement and officially reiterated in January and April 2000. See Thomas R. Wilson, Director of the Defense Intelligence Agency, "Global Threats and Challenges Through 2015," Testimony before the Senate Select Committee on Intelligence, February 7, 2001.

[36] While the last major review of US nuclear forces, the NPR of 1993–94, focused mainly on Russia because it "controls the only nuclear arsenal that can physically threaten the survivability of US nuclear forces," the NPR also explicitly "considered the size and role of US nuclear forces in a world in which the proliferation of nuclear

United States with myriad new security challenges. For example, in recent Senate testimony, George Tenet, the director of the Central Intelligence Agency, assessed that:

> Over the next 15 years, however, our cities will face ballistic missile threats from a wider variety of actors—North Korea, probably Iran, and possibly Iraq. . . . About a dozen countries either have offensive biological warfare programs or are pursuing them. Some want to use them against regional adversaries, but others see them as a way to counter overwhelming US and Western conventional superiority.[37]

Similarly, Vice Admiral Thomas Wilson, the director of the Defense Intelligence Agency, testified before Congress that over the next 15 years:

> We will continue to face strategic nuclear threats from Russia and China, and eventually from North Korea and other "rogue" states. While the total number of warheads targeted against us will be much lower than during the Cold War, the mix of threat nations, force structures, capabilities, and employment doctrines will complicate the strategic threat picture.[38]

In its review of ballistic missile threats to the United States, the Rumsfeld Commission concluded that:

> For those seeking to thwart the projection of U.S. power, the capability to combine ballistic missiles with weapons of mass destruction provides a strategic counter to U.S. conventional and information-based superiority. With such weapons, these nations can pose a serious threat to the United States, to its forward-based forces and their staging areas and to U.S. friends and allies.[39]

What might deter these rogue-state regimes from acquiring nuclear, chemical or biological weapons? Or from employing such weapons, if they succeed in acquiring them? It seems unlikely that a state possessing a handful of nuclear weapons would view the US nuclear deterrent differently if it comprised 3,500 warheads instead of 7,000, or 1,500 instead of 3,500. Moreover, deterring unstable regimes with small nuclear forces that may not subscribe to US notions of cost-benefit analysis may require a very different mix of military forces than those that were fielded to deter a Soviet nuclear strike.[40]

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weapons and other weapons of mass destruction, *rather than the nuclear arsenal of a hostile superpower*, poses the greatest security risk." Emphasis added. William J. Perry, *Annual Report to the President and the Congress* (Washington, DC: Department of Defense, February 1995), pp. 84–85.

[37] George Tenet, director of the Central Intelligence Agency, "The Worldwide Threat in 2000: Global Realities of Our National Security," Statement before the Senate Select Committee on Intelligence, February 2, 2000.

[38] Vice Admiral Thomas Wilson, director of the Defense Intelligence Agency, "Military Threats and Security Challenges Through 2015," Statement before the Senate Select Committee on Intelligence, February 2, 2000.

[39] Executive Summary of the *Report of the Commission to Assess the Ballistic Missile Threat to the United States*, July 15, 1998, conducted pursuant to Public Law 201, 104th Congress, n.p.

[40] The subject of how the United States might deter the leaders of rogue states from employing weapons of mass destruction is gaining increasing attention. One of the more interesting efforts is that undertaken by Stephen Peter Rosen, who hypothesizes that the leaders of such states have incentive structures that are closer to those of criminal leaders than of statesmen. If so, we might expect these leaders to run more risks than did the Soviet leadership

Early clues as to how the United States might deal with the threat of proliferation, or its consequences, in the post-Cold War era were not long in coming. War in the Persian Gulf and a crisis on the Korean Peninsula found the US military confronting states that not only possessed chemical (and perhaps biological) weapons, but that also seemed uncomfortably close to developing nuclear weapons.[41] Yet in the Gulf War, the Cold War pattern of nonnuclear strategic-strike operations persisted. Even though Iraq had neither nuclear weapons nor a nuclear-armed, great-power sponsor to shield it, strategic strikes conducted by US forces in the Gulf War, as in the case of earlier regional wars involving North Korea and North Vietnam, did not involve the use of nuclear weapons. As President George Bush and his national security advisor, Brent Scowcroft, noted during their meeting at Camp David on December 24, 1990: "No one advanced the notion of using nuclear weapons, and the President rejected it even in retaliation for chemical and biological attacks."[42] Indeed, after conducting a secret assessment of possible nuclear-strike options, including an analysis of how many tactical nuclear weapons would be required to seriously damage a single Iraqi armored division dispersed in the desert, the Chairman of the Joint Chiefs of Staff, General Colin Powell, commented, "If I had any doubts before about the practicality of nukes on the field of battle, this report clinched them."[43] Gulf War operations did, however, witness the first intensive use of PGMs.[44]

The value of nuclear forces seemingly declined even further during the crisis over North Korea's development of nuclear weapons, which culminated in the summer of 1994. General Charles "Chuck" Horner, the commander of the Gulf War strategic air campaign against Iraq, declared that, even if a war erupted and North Korea employed a nuclear weapon against South Korea, he would not recommend the use of nuclear weapons in a strategic-strike campaign against the

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during the Cold War. We might also expect these leaders to have relatively short time horizons when it comes to weighing the prospective costs and advantages of a particular course of action.

[41] Office of the Secretary of Defense, *Proliferation: Threat and Response* (Washington, DC: GPO, April 1996), pp. 4–9, 17–24.

[42] George Bush and Brent Scowcroft, *A World Transformed* (New York: Knopf Press, 1998), p. 463.

[43] According to Colin Powell, then chairman of the Joint Chiefs of Staff, the Department of Defense (DoD) did give a perfunctory look at nuclear options during the run-up to Desert Storm. Recalling that Secretary of Defense Dick Cheney questioned using nuclear weapons, Powell noted that "I jotted it down in my notebook simply as 'Prefix 5,' my nuclear qualification code dating back to my Infantry Officers Advanced Course at Fort Benning in 1964. 'Let's not even think about nukes,' I said. 'You know we're not going to let that genie loose.' 'Of course not,' Cheney said. 'But take a look to be thorough and just out of curiosity.' I told Tom Kelly to gather a handful of people in the most secure cell in the building to work out nuclear strike options. The results unnerved me. To do serious damage to just one armored division dispersed in the desert would require a considerable number of small tactical nuclear weapons. I showed this analysis to Cheney and then had it destroyed. If I had any doubts before about the practicality of nukes on the field of battle, this report clinched them." See Colin L. Powell with Joseph E. Persico, *My American Journey* (New York: Random House, 1995), pp. 485–86. Although the United States did not employ nuclear weapons in the Gulf War, it should be noted that US officials did make veiled nuclear threats to deter Saddam Hussein from using chemical or biological weapons. Regarding the nuclear threats, see Daniel Byman, Kenneth Pollack and Matthew Waxman, "Coercing Saddam Hussein: Lessons from the Past," *Survival*, vol. 40, Autumn 1998, pp. 132–33, 150.

[44] Keaney and Cohen, *Gulf War Air Power Survey*, pp. 226, 241. In the Gulf War, more than 17,000 PGMs were expended as opposed to approximately 210,000 unguided bombs. Precision-guided munitions were also employed during the Vietnam War, but far less intensively. More than twice as many laser-guided bombs were dropped during the *six-week* Desert Storm air campaign than were used against North Vietnam in the *nine-month* long Linebacker operations. Thus one can calculate the intensity of Gulf War PGM strikes as being roughly *an order of magnitude greater* in intensity than those conducted during the Vietnam War Linebacker operations.

Pyongyang regime. Rather, he would prefer to rely extensively on PGMs in air operations directed against the North's strategic center of gravity.[45]

The classified Presidential Decision Directive (PDD) 60, signed by President Clinton in November 1997, while still ambiguous, would appear to rule out nuclear strikes as an option for responding to a chemical or biological attack by a *nonnuclear* power. As Robert Bell, the former Special Assistant to the President for National Security Affairs, commented in March 1998:

> The PDD also reaffirmed our negative security assurance policy; that is, it is the policy of the United States, as restated in this PDD, not to use nuclear weapons first in a conflict unless the state attacking us or our allies or our military forces is nuclear-capable or not in good standing under the NPT or an equivalent regime, or third, is attacking us in alliance with a nuclear capability.[46]

However, other official statements regarding the declaratory policy of the United States are either considerably more ambiguous or actually reserve the right of nuclear first use in response to a large-scale chemical or biological attack. Defense Secretary William Cohen recently commented, for example, that: "We think that the ambiguity involved in the issue of use of nuclear weapons contributes to our own security, keeping any potential adversary who might use chemical or biologicals unsure of what our response would be."[47] Similarly, the official joint doctrine for nuclear operations specifically mentions deterrence of *all* types of weapons of mass destruction:

> The fundamental purpose of U.S. nuclear forces is to deter the use of weapons of mass destruction. . . . Deterrence of the employment of enemy WMD, whether it be nuclear, biological or chemical, requires that the enemy leadership believes the United States has both the ability and will to respond promptly with selective responses that are credible (commensurate with the scale or scope of enemy attacks and the nature of US interests at stake) and militarily effective.[48]

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[45] Similarly, former Secretary of Defense William Perry told Congress, "If some nation were to attack the United States with chemical weapons, then they would have to fear the consequences of a response from any weapon in our inventory . . . [but] in every situation that I have seen so far, nuclear weapons would not be required for a response." As quoted by Dr. Kathleen Bailey, former assistant secretary of the Arms Control and Disarmament Agency for Nonproliferation, Statement before the Subcommittee on Strategic Forces, Senate Armed Services Committee, Hearing on Nuclear Deterrence, March 31, 1998.

[46] Robert Bell, "Strategic Agreements and the CTB Treaty: Striking the Right Balance," *Arms Control Today*, January/February 1998.

[47] Mark Matthews, "NATO Nuclear Rift Widens—Session Finds Bonn gaining Allies against U.S. First-Use Policy," *Baltimore Sun*, December 9, 1998. See also Dana Priest and Walter Pincus, "U.S. Rejects 'No First Use' Atomic Policy: NATO Needs Strategic Option, Germany Told," *Washington Post*, November 24, 1998, p. A24; and Marc Rogers and Bryan Bender, "NATO Leaders Reject Review of Nuclear Deterrent Strategy," *Jane's Defence Weekly*, December 2, 1998.

[48] Joint Chiefs of Staff, Office of the Chairman, *Doctrine for Joint Nuclear Operations*, Joint Publication 3–12, April 1993. Similarly, during testimony to the Senate Foreign Relations Committee, former Secretary of Defense William Perry stated, "We have an effective range of alternative capabilities to deter or retaliate against the use of CW," and in the event of an attack, "the whole range would be considered. We have conventional weapons, also advanced conventional weapons—precision-guided munitions, tomahawk land-attack missiles—and then we have *nuclear* weapons." Emphasis added. Senate Foreign Relations Committee, *Convention on Chemical Weapons (Treaty Doc. 103-21)*, 104th Congress, 2nd session (Washington, DC: GPO, 1996), pp. 121, 124, 135.

While there is no question that the United States has the ability to respond promptly and effectively, the will of US policy officials to escalate to nuclear use for an enemy provocation short of nuclear attack is very much in doubt. In short, while there is deterrence value in maintaining a degree of calculated ambiguity, the threat of US nuclear retaliation to chemical and biological attacks may not be very credible.[49]

THE MILITARY REVOLUTION

Traditional ways of thinking about nuclear forces become even more problematic when the emerging military revolution is taken into account.[50] Military revolutions have occurred periodically for centuries. They are often stimulated by major surges in technology that facilitate a discontinuous leap in military effectiveness over a relatively short period of time. The last military revolution in nonnuclear forces occurred between the world wars, when mechanized armored forces came of age on land, aircraft carriers supplanted the battleship at sea and strategic aerial bombardment was established as a new way of war. In mid century, the introduction of nuclear weapons led strategists to rethink, in fundamental ways, the calculus of war, yielding yet another revolution in warfare.

These transformations of war typically displace, or render obsolete, some formerly dominant weapons and forces central to the previous military regime. Thus the tank consigned the horse cavalry to the pages of history, while the world's major navies ceased producing battleships following the carrier's rise to primacy. In terms of strategic aerial bombardment of an enemy state, nuclear weapons rapidly displaced conventional weaponry. Once the United States had fabricated several hundred nuclear weapons, the results of several years of US strategic conventional bombing against Germany and Japan in World War II could be duplicated (indeed, far exceeded) by a few hours of nuclear bombardment, even against the world's largest country, the Soviet Union.[51]

Just as dramatic technological advances in mechanization, aviation and radio stimulated a transformation in the character of conflict between the two world wars, today the military confronts the challenge of interpreting the impact of a revolution in information technologies. These technologies offer advanced military organizations like the US military the potential to locate, identify and track a far greater number of targets, over a far greater area and for far longer periods of time, and to engage those targets with far greater lethality, precision and discrimination than has ever before been possible.

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[49] In 1991, General Lee Butler, then commander in chief of STRATCOM, assured Congress that although the United States would be *unlikely* to initiate nuclear attacks, "I don't know that there would be a great deal to be gained . . . by assuring some potential adversary, not necessarily the Soviet Union . . . who has access to and a penchant to use biological or chemical weapons, to give them the absolute assurance that we would never use nuclear weapons first." As quoted in Janne Nolan, *An Elusive Consensus–Nuclear Weapons and American Security after the Cold War* (Washington, DC: Brookings Institution Press, 1999), p. 67.

[50] See Andrew F. Krepinevich, Jr., *The Military-Technical Revolution* (Unpublished paper, Department of Defense, July 1992); Andrew F. Krepinevich Jr., "Keeping Pace with the Military-Technological Revolution," *Issues in Science and Technology* (Summer 1994); Andrew F. Krepinevich Jr., "Cavalry to Computer: The Patterns of Military Revolutions," *The National Interest* (Fall 1994); and Michael G. Vickers, *Warfare in 2020: A Primer* (Washington, DC: Center for Strategic and Budgetary Assessments, 1996).

[51] See Rosenberg, "Smoking Radiating Ruin," pp. 3–38.

The implications for strategic-strike operations—and for how militaries view nuclear weapons—are potentially profound. In one sense, they recall the old parable of the tortoise and the hare. When nuclear weapons came upon the scene, they quickly outdistanced conventional weapons as the preferred means for conducting strategic bombardment missions (although, as noted above, in practice, strong political and moral considerations led the United States to conduct strategic bombing campaigns in Korea, Vietnam and Iraq employing conventional weapons only). As nuclear weapons were produced in substantial numbers during the 1950s, the US Strategic Air Command oriented its forces almost exclusively on conducting nuclear attacks.

But the emerging military revolution is enabling the conventional tortoise to narrow the gap between itself and the nuclear hare. For example, during 1943, the US Eighth Air Force was able to strike roughly fifty strategic targets in the war against Germany. In 1991, however, during the Persian Gulf War, coalition air forces (overwhelmingly represented by the United States) struck approximately three times as many targets *on the first day of the war*.[52] This represents a two-order-of-magnitude increase in conventional strategic-strike capability. But that is only part of the story. Precision munitions comprised about *seven percent* of the conventional munitions employed in bombing attacks during the Gulf War. According to the Gulf War Air Power Survey conducted following the war, those aircraft employing precision munitions were typically *an order of magnitude more effective* in terms of target/sortie ratios than aircraft employing dumb conventional bombs.[53] In total, over 16,000 PGMs, 288 Tomahawk Land-Attack Missiles (TLAMs) and 35 Conventional Air-Launched Cruise Missiles (CALCMs) were used to attack Iraqi targets.

Since 1991, the use of conventional precision-strike weapons to attack military and strategic targets has blossomed. In four of the last five recent US power-projection operations, PGMs accounted for over sixty percent of the total ordnance used against enemy targets (see Table 2). In several cases, the percentage of PGM usage has increased by over an order of magnitude since the Gulf War. In fact, long-range, precision-strike weapons were the *only* weapons used in both Operation Desert Strike, conducted against Iraq in 1996, and Operation Infinite Reach, involving deep strikes against targets in Sudan and Afghanistan in 1998. In 1999, in Operation Allied Force against Serbia, a total of over 8,000 precision weapons were used to target, among other things, government and military headquarters, command and control sites, integrated air defense systems, electric power infrastructure, and petroleum-related production facilities.

Table 2: US Conventional Precision Strike Trends since the Gulf War

[52] On the first night of the Gulf War, coalition forces attacked 144 different targets. On average, each target comprised approximately 2.5 aim points, for a total of 370 aim points. See Keaney and Cohen, *Gulf War Air Power Survey: Planning and Command and Control*, Summary Report (Washington, DC., HQ USAF, 1993), p. 189. See also Christopher Bowie, *Untying the Bloody Scarf: Casualties, Stealth, and the Revolution in Aerial Combat* (Arlington, VA: IRIS Independent Research, 1998), p. 14; and General Ronald R. Fogleman, "Getting the Air Force into the 21st Century," Speech delivered to the Air Force Association's Air Warfare Symposium in Orlando, Florida, on February 24, 1995.

[53] Keaney and Cohen, *Gulf War Air Power Survey,* p. 243. The ratio was derived by examining 12 representative sorties of F-117 and F-111F aircraft carrying PGMs with 12 sorties flown by aircraft delivering unguided bombs. The former covered 26 targets employing a total of 28 PGMs, while the latter covered two targets, expending 168 bombs.

Source: Internal CSBA research based on numerous sources.

In addition, Operation Allied Force may also have witnessed the first combat use of computer network attack (CNA) capabilities by the US military. An information operations (IO) cell reportedly launched attacks against the command and control infrastructure supporting Serbia's integrated air defenses (IAD). Part of the effort involved manufacturing and inserting false radar images and signal intelligence intercepts into the Serbian IAD system.[54] Only a small portion of the offensive information warfare toolbox was apparently used, however. According to Admiral Ellis, commander of Joint Task Force Noble Anvil, "Properly executed, IO could have halved the length of the campaign. . . . All the tools were in place . . . [but] only a few were used."[55]

Complementing these limited information warfare attacks, electronic power distribution munitions (EPDMs) containing spools of fine, electrically conductive filaments were used to wreak havoc with Serbia's electrical power infrastructure (e.g., power stations and transformer yards). Conductive filaments shorted out high voltage lines and caused five power grids to fail, temporarily cutting off electricity to 70 percent of the country.[56]

As noted earlier, dramatic surges in technology have often in the past led to equally dramatic changes in the conduct of war. Often times these changes displace formerly dominant systems and concepts of operation. The emerging military revolution seems likely to blur what was once a relatively clear distinction between nuclear and conventional weapons. The US military may soon be capable of conducting nonnuclear strategic-strike operations at levels of military effectiveness approaching those of nuclear strikes but without the political barriers associated with the latter form of strikes (see Figure 1). Nonnuclear options will not be able to inflict the

[54] David Fulghum, "Yugoslavia Successfully Attacked by Computers," *Aviation Week & Space Technology*, August 23, 1999, p. 31, 34. See also David Fulghum, "Telecom Links Provide Cyber-Attack Route," *Aviation Week & Space Technology*, November 8, 1999, p. 81; and Bob Brewin, "Kosovo Ushered in Cyberwar," *Federal Computer Week*, September 27, 1999, p. 1.

[55] Andrew Rathmell, "Information Operations—Coming of Age?", *Jane's Intelligence Review*, May 2000, p. 52.

[56] David Fulghum, "Electronic Bombs Darken Belgrade," *Aviation Week & Space Technology*, May 10, 1999, pp. 34–36; and David Fulghum, "Russians Analyze U.S. Blackout Bomb," *Aviation Week & Space Technology*, February 14, 2000, p. 59.

same level of damage as quickly as nuclear weapons, but they may, in some cases, be able to neutralize *specific classes of strategic targets* at a comparable level of effectiveness. As General Charles Horner acknowledged, "we now have a conventional strength that really can offset a very limited nuclear strength."[57] Similarly, Stephen Younger, the associate director for nuclear weapons at Los Alamos National Laboratory, has recently asserted that, "Advances in conventional weapons technology suggest that by 2020 precision long-range conventional weapons may be capable of performing some of the missions currently assigned to nuclear weapons."[58]

[57] "Questioning Nuclear Arms," interview with General Charles Horner on the Lehrer Newshour, December 4, 1996. A transcript of this interview is available on-line at: www.pbs.org/newshour.bb.military.nuclear_debate12-4.html.

[58] Stephen M. Younger, "Nuclear Weapons in the Twenty-First Century," Los Alamos National Laboratory Document No. LAUR-00-2850, June 27, 2000, p. 1. Available on-line at: www.fas.org/nuke/guide/usa/doctrine/doe/younger.htm

Figure 1: Progression of Conventional Precision Strike Capability over Time

III. A NEW STRATEGIC TRIAD?

THE CHANGING STRATEGIC TARGET SET

As the world continues its transition away from industrial-based economies and toward information-based ones, there will likely be a corresponding shift in the principal sources of military, economic and political power of states. The character of the strategic target base will necessarily change to reflect these developments.[59] Unlike old World War II newsreels showing massive bomber raids on steel plants, and fire storms ignited by incendiary bombs, or Cold War era films projecting horrific images of the aftermath of atomic explosions, future strategic warfare may instead capitalize on well-placed conventional and electronic strikes discretely directed against critical elements, or nodes, of an adversary's center of gravity.

New strategic targeting priorities will likely encompass key data processing and routing facilities (both civilian and military), major trunks of the Internet backbone, satellite uplinks and downlinks, transportation control systems (e.g., traffic lights, aircraft traffic control, railroad switching), power grid controls, computerized gas and oil distribution systems, and electronic banking and commerce.[60] This is not to suggest, however, that an information-related target set will completely supplant the one with which we have grown familiar since World War II. Strikes against an adversary's military forces-in-being (e.g., major ports, submarine pens, airfields, garrisons, and depots), and to a lesser extent, against its high-value industries will remain strategically profitable. This may be especially true with adversaries that are just beginning, or have not yet begun, to make the transition toward an information-based economy.

ADVANCES IN CONVENTIONAL PRECISION STRIKE

The prospective shift in the conduct of strategic-strike operations stems in large measure from three synergistic developments: the emergence of more capable ISR systems; revolutionary advances in data processing coupled with the rise of robust information networks; and the maturation and growing availability of PGMs and delivery platforms that can effectively exploit this new wealth of information. With respect to this last capability, for example, the US military is already in the process of developing, fielding and refining several promising systems, including the following:

[59] For a discussion of redefining strategic target sets, see Carl H. Builder, *The Prospects and Implications of Non-nuclear Means for Strategic Conflict*, Adelphi Paper No. 200 (London: International Institute for Strategic Studies, 1985), p. 2.

[60] For more information on potential information infrastructure targets see *Report of the Defense Science Board Task Force on Information Warfare–Defense*, (Washington, DC: Department of Defense, November 1996); and "Critical Foundations: Protecting America's Infrastructures," *Report of the President's Commission on Critical Infrastructure Protection* (Washington DC: President's Commission on Critical Infrastructure Protection, October 1997). Hereafter the *Report of the President's Commission on Critical Infrastructure Protection* is referred to as the Marsh Commission Report.

- Relatively inexpensive, air-delivered PGMs such as the Joint Direct Attack Munition (JDAM) that can strike targets between 10–30 kilometers away from the point of release;[61]

- Stand-off precision-strike weapons such as the Joint Air-to-Surface Stand-off Missile (JASSM), with a range of over 300 kilometers and accuracy on the order of three meters; the Navy's Stand-off Land Attack Missile-Expanded Response (SLAM-ER), has an effective range over 250 kilometers and an automated target recognition (ATR) capability; and the Joint Stand-Off Weapon (JSOW) with a glide range between 70–80 kilometers when launched from high-altitude;[62]

- Long-range, sea-based precision-strike weapons such as the Navy's TLAM, with a range of over 1,800 kilometers;[63]

- CALCMs, which have a range on the order of 1,200 kilometers, and Extended Range Cruise Missiles (ERCMs) with a range of more than 1,800 kilometers;[64]

- Smart weapons such as the Low-Cost Autonomous Attack System (LOCAAS), which can loiter over the battlefield and identify, track and engage multiple, dispersed targets;[65] and

- Laser-guided ground penetrators or bunker busters such as the Guided Bomb Unit-28 (GBU-28), which can penetrate over 20 feet of concrete or 100 feet of earth.[66]

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[61] The JDAM is essentially a tail kit that can be attached to existing 1,000 and 2,000 pound unitary warhead bombs. The traditional range of the JDAM is about 12.9 kilometers when dropped from 20,000 feet. But by using a new compressed-wing tail kit, the JDAM-ER reportedly has a range of 38.6 kilometers. By using the data provided by a GPS-aided inertial guidance system, the tail kit can guide a previously dumb bomb to within about 10 meters of its target. Bryan Bender, "JDAM's Range Trebled," *Jane's Defence Weekly*, May 3, 2000. The JDAM's unit cost is about $14,000 and the US military is planning to procure approximately 87,000 of them. Patrick Sloyan, "Bargain Basement Bomb," *Long Island Newsday*, November 14, 1999, p. 23. See also Mark Walsh, "Pentagon Eyes Savings with Smart Bombs," *Defense News*, April 21–27, 1997, p. 28.

[62] The US Air Force currently plans to acquire more than 4,000 JASSMs. "Future Cruise Will Offer Greater Speed, Guaranteed Destinations," *Jane's International Defence Review*, February 2000, p. 59.

[63] The range indicated is for the TLAM Block III missile. The upcoming Block IV missile, or Tactical Tomahawk, will possess a range between 1,800 to 2,700 kilometers and will be significantly cheaper ($575,000 vs. $1.4 million). It may also be able to loiter above the target area for over two hours and receive in-flight re-targeting instructions. See Michael Dornheim and David Fulghum, "New Tomahawks to Be Retargetable," *Aviation Week & Space Technology*, August 31, 1998, pp. 35–36. See also David A. Fulghum, "New Tomahawks Offer Low Price and Agility," *Defense News*, September 8, 1997.

[64] The CALCM (AGM-86C) was originally designed as a nuclear delivery system and has since been converted to a conventional role. More than 300 nuclear ALCMs were converted between 1985 and 1997. In part to compensate for expenditures in Operation Desert Fox and Operation Allied Force, the Air Force ordered 322 more conversions for delivery by mid-2001. The final batch of 50 missiles will be armed with a warhead designed to penetrate hardened-targets. The Air Force currently plans to buy over 600 ERCMs. "Future Cruise Will Offer Greater Speed, Guaranteed Destinations," p. 58; and Robert Wall, "Quick Development Planned for Longer Range Missiles," *Aviation Week & Space Technology*, July 3, 2000, p. 37.

[65] The powered version of the LOCAAS will be able to loiter for up to 30 minutes while searching a 33 nautical-mile-square area. Clifford Beal, "Brave New World," *Jane's Defence Weekly*, February 9, 2000, pp. 25–26. See also Craig Covault, "LOCAAS Sensor Tests Advance," *Aviation Week & Space Technology*, October 27, 1997, p. 72.

[66] Penetration depth is based on a GBU-28 with BLU-113 warhead. www.fas.org. Several other penetrators are under development including Lockheed Martin's Advanced Unitary Penetrator (AUP-3) and BAE Systems' Broach two-stage warhead.

While these developments are impressive in and of themselves, precision-strike capabilities will mature even more over the course of the next two decades. Not only will the PGMs described above become more advanced and available in far greater numbers, but the US military may deploy capabilities that are now only on the drawing board such as:

- Converted SSBNs or built-for-purpose cruise missile submarines (SSGNs) capable of penetrating heavily defended littoral waters and launching up to 154 precision-guided missiles including TLAMs, a naval variant of the Army Tactical Missile System (ATACMS), JASSMs, and standard missile variants;[67]

- Ground-based, unmanned, remotely-controlled missile platforms capable of firing "dozens" of long-range missiles or other precision-guided weapons;[68]

- Stored Undersea Strike Platforms containing hundreds of missiles, which could be towed to an area of interest by a submarine, anchored to the ocean floor and remotely fired when needed;[69]

- Hypersonic air- and sea-launched missiles that will be better able to attack mobile, time-critical targets, as well as deep underground facilities;[70]

- Long-endurance, unmanned combat air vehicles (UCAVs) that could conduct precision strikes on fixed and mobile ground targets, as well as electronic strikes against an adversary's C4ISR nodes;[71]

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[67] The ATACMS is a semi-ballistic, GPS-aided missile with a range between 130–200 kilometers. John Donnelly, "Navy Focuses on Tridents as Arsenal Subs," *Defense Week*, April 21, 1997, pp. 1, 14. See also Jim Courter and Loren Thompson, "Arsenal under the Sea," *Sea Power*, June 1997, pp. 41–44.

[68] This emerging weapon system was referred to by the 1998 DSB Summer Study as "Missiles/Smart Rounds in a Box." Defense Science Board 1998 Summer Study Task Force, *Joint Operations Superiority in the 21st Century*, (October 1995), Volume II, Chapter 1. See also Ernest Blazar, "Tomorrow's Instant War," *Washington Times*, January 1, 1999, p. 8.

[69] The Stored Undersea Strike Platforms concept was also recommended by the 1998 DSB Task Force in *Joint Operations Superiority in the 21st Century.*

[70] DARPA recently launched the Affordable Rapid Response Missile Demonstrator (ARRMD) program. The objective is to develop a hypersonic missile (with a speed of around Mach 8) by 2005 with a range between 740 to 1,100 kilometers and a unit cost of no more than $200,000. When attacking hard and deeply buried targets, the ARRM is expected to have an impact speed of 1,200 meters per second. "Future Cruise Will Offer Greater Speed, Guaranteed Destinations," p. 60. See also Robert Wall and David Fulghum, "Combat Weakness Triggers New Research," *Aviation Week & Space Technology*, February 16, 1998, p. 25. The US Navy is also developing a hypersonic follow-on to the Tomahawk, often referred to as "Fasthawk," under the Low-Cost Missile (LCM) and HyStrike programs. This missile is expected to employ a ramjet-powered engine capable of a sustained speed of over Mach 4 and a range of over 700 miles. Robert Holzer, "U.S. Navy Eyes Fasthawk as Tomahawk Successor," *Defense News*, September 9–15, 1996, p. 1; and "Hystrike, High Speed Strike Missile, Fast Hawk, Low-Cost Missile," available at: www.fas.org/man/dod-101/sys/smart/hystrike.htm.

[71] The US Air Force Scientific Advisory Board has assessed that "UAV [Unmanned Aerial Vehicle] platform, sensor, and weapons technology have all matured sufficiently to permit low risk, rapid, and low-cost development and application of weaponized UAVs in the near-term (1996–2005)." United States Air Force Scientific Advisory Board, *Report on UAV Technologies and Combat Operations* (Washington, DC: Department of Defense, 1996), n.p.. For additional information on current UAV weaponization efforts see Paul Richter, "Pilotless Plane Pushes the Envelope for U.S. Defense," *Los Angeles Times*, May 14, 2000, p. 1; Dave Moniz, "Pilotless Bomber to Be Tested Next Year," *USA Today*, August 21, 2000, p. 8; John Tirpak, "UCAVs Move toward Feasibility," *Air Force*

- Hypersonic bombers or space planes capable of striking any point on the globe in less than two hours;[72]

- Reusable, suborbital Space Operations Vehicles (SOVs) equipped with Common Aero Vehicles (CAVs) that could conduct precision strikes against targets anywhere in the world "within tens of minutes" from launch from the continental United States (CONUS); [73] and

- Space-based strike systems capable of precise, nearly instantaneous delivery of munitions (e.g., depleted uranium rods) against virtually any target on the earth.[74]

It should be noted that many of the capabilities enumerated above share one or more of the following characteristics: stealth, extended striking range, accuracy, and/or speed of attack. Given adequate funding, it is certainly plausible that over the next two decades some of these weapon systems could be deployed in strategically significant quantities and increase the conventional striking power of the US military by more than an order of magnitude.

EMERGENCE OF ELECTRONIC STRIKE CAPABILITIES

Former CIA Director John Deutch testified to Congress, "the electron is the ultimate precision-guided weapon."[75] This may well be true. For instance, electronic strikes could be carefully directed against a few selected nodes that are highly valued by an adversary. However, they also could be used to cause widespread disruption of an adversary's information-reliant infrastructures with major strategic repercussions.

Magazine, March 1999, pp. 32–37; Mark Hewish, "Coming Soon: Attack of the Killer UAVs," *Jane's International Defense Review*, September 1999, pp. 30–38; Damian Kemp, "Combat Drones Fly for Casualty-Free War," *Jane's Defence Weekly*, June 9, 1999, pp. 88–90; David Mulholland, "U.S. Studies UCAVs for Risky Combat Missions," *Defense News*, September 14–20, 1998, pp. 18, 26; and David Fulghum, "Unmanned Strike Next for Military," *Aviation Week & Space Technology*, June 2, 1997, pp. 47–55.

[72] Preliminary studies have been initiated on a bomber capable of skipping atop the earth's atmosphere at Mach 10. The project has been dubbed "HyperSoar." By ascending to approximately 40 kilometers and then skipping off the Earth's upper atmosphere, the Hypersoar aircraft could theoretically deliver a 45,000-kilogram payload out to a mission radius of 10,000 kilometers. For more information, see Scott Gourley, "Soaring Ambitions," *Jane's Defence Weekly*, October 21, 1998, pp. 36–37; William B. Scott, "Airbreathing Hypersoar Would 'Bounce' on Upper Atmosphere," *Aviation Week & Space Technology*, September 7, 1998, pp. 126–30; and Bill Sweetman, "Securing Space for the Military: Hypersonic Military Spaceplanes Go Quietly about Their Business," *Janes International Defense Review*, March 1999, pp. 49–55.

[73] According to the DSB, "The SOV would provide aircraft-like access to Mach 17+ energy states for intercontinental projection of lethal or non-lethal power using the CAV and miniature munitions technology. . . . Currently, the Air Force has Boeing and Lockheed Martin under contract to study both the SOV and the CAV concepts." For more details on these weapon-system concepts and a brief discussion of the envisioned concept of operations approved by the Commander of Air Force Space Command, see DSB 1998 Summer Study Task Force, *Joint Operations Superiority in the 21st Century*, pp. 30–32 and H1–H7.

[74] While technically possible, the development of space-based weapons would require overcoming significant political obstacles. For additional information on the technical feasibility of space-based strike systems, see United States Air Force Scientific Advisory Board, *New World Vistas–Air and Space Power for the 21st Century*, Space Applications Volume, (December 1995), pp. 83–87; and Dietrich Schroeer, *Directed-Energy Weapons and Strategic Defense*, Adelphi Paper 221, (London: International Institute for Strategic Studies, Summer 1987).

[75] Graeme Browning, "Hack Attacks," *Government Executive*, August 1997, p. 23.

The term "electronic strike," as used here, is meant to encompass both offensive information operations and strategic electronic warfare.[76] Information operations involve the intentional manipulation of digital data (e.g., inserting malicious code into an adversary's computer system), whereas electronic warfare refers to the use of weapons that are specially designed to disrupt or physically destroy electronic equipment such as high-power microwave (HPM) or conventionally generated electromagnetic pulse (EMP) weapons. The emergence and maturation of a broad range of electronic-strike capabilities could provide a qualitatively new means for conducting strategic warfare in the years ahead.

For obvious security reasons, the specific tools and techniques of offensive information warfare (IW) and electronic strike are highly classified and compartmentalized within the US intelligence, military, and policy-making communities. The manual outlining Joint Doctrine for Information Operations (Joint Pub 3-13), for instance, sheds little light on the conduct of offensive information operations beyond the assertion that "IO may be used to effectively attack strategic targets, while minimizing potentially devastating social, economic, and political effects normally associated with conventional military operations."[77] Similarly, the Marsh Commission on Critical Infrastructure Protection notes simply that "offensive IW, in brief, uses computer intrusion techniques and other capabilities against an adversary's information-based infrastructures."[78] When asked during congressional testimony whether the United States is developing offensive IW capabilities, George Tenet, the director of Central Intelligence, responded that the nation can rest assured that "we're not asleep at the switch in this regard."[79]

In late 1999, the Pentagon publicly acknowledged that the offensive information warfare mission was being moved to US Space Command (SPACECOM). A newly assembled Joint Task Force–Computer Network Attack (JTF-CNA) became operational on October 1, 2000. General Richard Myers, the commander in chief (CINC) of SPACECOM, said he viewed offensive information warfare as "one more arrow in the quiver" of weapons in the US arsenal.[80]

Beyond these ambiguous statements, what more can be said about this new form of strategic warfare? To address this question, this paper will first explore the types of strategically relevant targets that could be profitably attacked with electronic strikes, and then describe, in general terms, how these attacks might be conducted.

The Marsh Commission, created by President Clinton in 1997, was tasked with studying "the critical infrastructures that constitute the life support systems of our nation."[81] Assuming that

[76] The term "strategic" electronic warfare is meant to exclude traditional, operational-level EW missions such as jamming.

[77] Joint Chiefs of Staff, *Joint Doctrine for Information Operations*, Joint Pub 3-13, (October 9, 1998), pp. II–10.

[78] Marsh Commission Report, p. 17.

[79] Bradley Graham, "Authorities Struggle to Write the Rules of Cyberwar—Consequences of Using Computers as Weapons Are Largely Unexamined," *Washington Post*, July 8, 1998, p. 1.

[80] United States Space Command, "U.S. Space Command Takes Charge of Computer Network Attack," News Release No. 15-00, September 29, 2000; Bill Gertz, "U.S. Set to Take Warfare On-Line," *Washington Times*, January 6, 2000, p. 3. See also Anne Plummer, "Computer Network Attack Mission to Move under SPACECOM in FY-01," *Defense Information and Electronics Report*, October 29, 1999, p. 1.

[81] Marsh Commission Report, p. ii.

other countries making the transition from an industrial to an information-based economy would have similar vulnerabilities, it seems reasonable to infer that the targets of US strikes might comprise the following core infrastructures: transportation; energy generation, transmission and distribution; banking and finance; civilian telecommunications; and military C4 systems (see Figure 2 below).[82]

Figure 2: Potential Electronic Strike Strategic Target Set

Transportation-related targets might include, for instance, automated traffic control systems (i.e., stop lights), aircraft traffic control and navigation systems, and railroad switching networks. Energy-related targets might comprise not only power plants that generate electrical power, but also the computerized systems that regulate the power grid and direct the flow of oil and gas through pipelines.[83] Banking and finance targets might range all the way from automated teller

[82] While these infrastructures could also be attacked with precision-strike weapons, the discussion here will focus exclusively on information and electronic strikes. The Marsh Commission actually focused on eight inter-related infrastructures: telecommunications, electric power, banking and finance, transportation, oil and gas delivery and storage, water, emergency services, and continuity of government services. For illustrative purposes electric power and oil/gas delivery and storage have been aggregated, and water and emergency services have been omitted because of the relatively limited vulnerability of these infrastructures to information and electronic strikes. Water pumping and treatment facilities remotely controlled by computer-based Supervisory Control and Data Acquisition (SCADA) systems might be vulnerable to IW attacks. However, it seems unlikely that such attacks would have enduring strategic effects. Similarly, while emergency services could be degraded indirectly by attacking public phone networks, there appear to be few options for directly attacking police, fire and other emergency services with information/electronic strikes.

[83] Like the United States, companies in several countries employ SCADA systems to manage utilities and services (e.g., power grids, oil and gas distribution, water service, etc.) remotely. SCADA systems could be vulnerable to offensive information operations. Attacks on these systems would not necessarily be limited to crashing the system or shutting down particular power substation or pumping facilities, but could actually cause physical damage. For instance, if accessed successfully, control programs for oil and gas pipelines could be manipulated to induce a hammering effect in pipelines, possibly causing them to burst. See Marsh Commission Report, p. A-28.

machine (ATM) networks relied upon by individual citizens, to bank databases affecting thousands of customers, to computer networks responsible for running a country's stock exchange and transferring large sums of money.

An adversary's civilian telecommunication infrastructure and military C4 network should be viewed as having both a physical and an information component.[84] The physical layer consists, for example, of miles and miles of copper wire and fiber optic cable; telephone switching stations and network management nodes; radio and television transmitters and receivers; microwave transmitters, repeaters, and receivers; satellite uplinks and downlinks; computer hard drives that store and retrieve data; and the computer servers and routers responsible for moving data around the Internet and military C4 networks. The information layer consists not only of the information stored on hard drives, which is often valuable in its own right, but also the software and network protocols that allow all of this data to be processed for some purpose and moved quickly and reliably.

All five of these strategically important infrastructures are dependent upon one another to varying degrees. As a result of this interdependence, an electronic attack upon one would likely have cascading effects upon several others. A successful strike against an adversary's power grid, for instance, would not only shut down industry and cause homes to go dark, but would likely cause a number of ripple effects: without traffic lights, automotive congestion would also likely become severe in urban areas; pumps would stop pushing oil and gas through pipelines; computer hardware relied upon by financial institutions and used to support the communication networks would eventually exhaust emergency power supplies; and radio, microwave and television transmitters would stop operating. As a second example, disrupting public telephone switching stations would not only severely degrade the flow of information over the civilian Internet and World Wide Web, but would severely upset military communications, as well as banking and financial services, which are heavily dependent upon public telecommunication networks for the movement of financial information. In sum, if they work as advertised, electronic strikes could rapidly induce strategic paralysis, collapsing the principal sources of an enemy's military, economic and political power.

While the physical elements of these interdependent infrastructures could be attacked with conventional, high-explosive weapons, it might be even more effective to employ specialized electronic-strike weapons. EPDMs, similar to those dropped against targets in Iraq in 1991 and Kosovo in 1999, could be used induce short circuits in power plants, telephone switching centers and other facilities using electrical equipment by dispensing extremely fine, conductive filaments. Conventionally generated EMP weapons and high-power radio frequency beams (e.g., microwave and millimeter-wave) could also provide a potent means for taking down these infrastructures.[85]

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[84] See Dr. David Mussington, "Throwing the Switch in Cyberspace," *Jane's Intelligence Review*, July 1996, p. 331.

[85] See, for example, David Ruppe, "Emerging Threat: Radio Frequency Weapons," *Defense Week*, March 2, 1998, p. 1; and Tony Capaccio and William Arkin, "Air Force Organizes for Offensive Info War," *Defense Week*, March 31, 1997, p. 7. For more detailed information on high-power, directed-energy weapon technologies see, for example, Board on Army Science and Technology, *STAR 21: Strategic Technologies for the Army of the 21st Century* (Washington, DC: National Academy Press, 1993), pp. 576–603.

Electronic strikes could also take the form of offensive information warfare strikes. These attacks could vary widely in respect to the tools and techniques employed.[86] Assuming an adversary's firewalls and other computer network security barriers could be penetrated successfully, computer network attacks might include some combination of the following:

- Damaging or altering software applications;
- Erasing or corrupting valuable data files;
- Manipulating network protocols in order to interfere with the routing of data packets across the adversary's information network; and/or
- Inserting malicious code, such as self-replicating viruses, into targeted computer networks.[87]

THE NEW STRATEGIC TRIAD

Given the changes in the strategic target base and the emerging precision- and electronic-strike capabilities discussed above, it would seem increasingly appropriate for the United States to consider fielding a new type of strategic triad. Such a triad would not be based solely on the traditional three types of delivery systems for nuclear weapons—bombers, land-based ballistic missiles and ballistic missile submarines. Rather, the new triad would comprise long-range, conventional precision-strike, electronic-strike and residual nuclear-strike forces (see Figure 3 below).[88]

Figure 3: New Strategic Triad

[86] For some additional information on the types of offensive IW techniques discussed, see *Report of the Defense Science Board Task Force on Information Warfare—Defense*, Section 2, pp. 11–17. See also Joint Chiefs of Staff, *Joint Doctrine for Information Operations*, Joint Pub 3-13.

[87] Some of the weapons that might be used to carry out such attacks include logic bombs that consume the processing capacity of the host platform at a rapid rate; self-replicating viruses that infect progressively larger volumes of data and greater numbers of computer systems over time; and Trojan horses, which can perform a wide array of pre-scripted functions while hiding within a legitimate computer program. Rather than a direct information strike, an adversary's computer network could also be disabled indirectly by network flooding, or the introduction of an unmanageable quantity of traffic into the adversary's network (e.g., sending thousands of messages per second to a targeted server). The goal of such an attack would be to overwhelm the system and prevent legitimate users from accessing and using the network. This type of information strike if often referred to as a denial of service attack.

[88] One consequence of the ongoing revolution in molecular biology is the likely emergence of advanced biological weapons that could be exploited for strategic ends. For instance, Secretary of Defense William Cohen has noted that recent scientific advances could soon lead to agents "designed to take out just certain types of people, depending on their genetic makeup." See Barbara Starr, "U.S. Department of Defense Reveals Horrific Future of Biological Wars," *Jane's Defence Weekly*, August 13, 1997, p. 6. See also Barbara Starr, "Bio Agents Could Target Ethnic Groups, Say CIA," *Jane's Defence Weekly*, June 25, 1997, p. 6; and Malcolm Dando, "Discriminating Bio-Weapons Could Target Ethnic Groups," *Jane's International Defense Review*, March 1997, pp. 77-78. Agents designed to attack and break down specific materials (e.g., fuel, rubber, silicon, kevlar, etc.) may soon be practical as well. Despite their prospective value as strategic weapons, this paper assumes that these types of emerging biological warfare-related technologies will not be pursued by the US military for legal, political and moral reasons. Military competitors of the United States may not be similarly constrained. See Michael G. Vickers and Robert C. Martinage, *The Military Revolution and Intrastate Conflict* (Washington, DC: Center for Strategic and Budgetary Assessments, October 1997), pp. 36–38.

Each leg of this new strategic triad would complement the others in a variety of ways. Conventional precision strikes, for example, could be used to sever fiber optic lines in order to force the adversary to use communication paths that are more susceptible to electronic attacks. Precision strikes could also be used to attack relatively soft nuclear-related command and control nodes, missile defense radars, and even vulnerable nuclear forces (e.g., bombers at airfields and submarines in port). Electronic strikes could be used to disrupt an enemy's integrated air and missile defenses, thereby making both conventional and nuclear strikes more effective. They could also be used to disrupt the connectivity between an adversary's leadership and its nuclear forces in the field. Nuclear weapons would be valuable in deterring an adversary from threatening or actually escalating to use of WMD in response to conventional precision strikes and electronic attacks. In effect, they would allow the United States to keep a given fight below the nuclear threshold. Without the backstop provided by residual nuclear forces, the strategic utility of the other two legs of the triad would be substantially diminished because a nuclear-armed adversary could credibly threaten to escalate to nuclear use in response to precision or electronic strikes.

Residual Nuclear Force Posture

The general character of the conventional precision- and electronic-strike legs of this new triad have already been discussed at length. But how might the nuclear leg of this new triad differ from today? Residual nuclear forces would be relied upon for two critical functions within this new triad: credibly threatening those strategic targets that cannot otherwise be disabled or destroyed by nonnuclear means; and second, serving as the ultimate guarantor of deterrence by holding an adversary's society at risk. While it is beyond the scope of this paper to provide a detailed nuclear force posture assessment, some preliminary thoughts regarding overall force size and composition are presented below.

Nuclear Weapons: How Much is Enough?

Assuming the United States maintains its declaratory policy of not using "nuclear weapons first in a conflict unless the state attacking us or our allies or our military forces is nuclear-capable or not in good standing under the NPT," a logical first step in determining targeting requirements is

to identify potential *nuclear-armed* adversaries. The roll, at present, might include Russia, China, and possibly India and Pakistan. States such as Iran, Iraq, and North Korea might be added to the list by the end of the decade.

From a nuclear deterrence perspective, the size of the prospective target set in each of these countries would be very dependent upon one's preferred targeting strategy. A pure, second-strike countervalue strategy that sought to deter a potential adversary by holding his economic and population centers at risk could be met with relatively few warheads. Most of the major cities in the countries mentioned above could be obliterated with tens, or at the most, hundreds of warheads. For example, according to the National Academy of Sciences, detonation of twenty 475-kiloton warheads would be sufficient to destroy Russia's 12 largest cities, killing 25 million people and destroying 25 percent of its industrial capacity.[89] Similarly, according to one estimate, four Chinese cities are populated by a total of over 20 million people and could be destroyed by as few as five warheads.[90]

In contrast, a counterforce targeting strategy, which seeks to deter an adversary by credibly threatening to destroy its present and future war-making capacity, would entail striking many more types of targets, including the following: [91]

- Nuclear, chemical and biological weapons infrastructure including hardened missile silos, garrisons for missile transporter-erector-launcher (TEL) vehicles, submarine pens, airfields, and weapon storage bunkers;

- Conventional military forces in being and their associated basing infrastructure (e.g., command posts, airfields, ports, assembly areas, ammunition bunkers, air defense networks);

- Military and civilian command and control nodes (e.g., underground bunkers, communication facilities);

- Military-related industry including ammunition and missile plants, aircraft manufacturing facilities, ground vehicle production sites, and ship builders;

- Petroleum and electrical power production and distribution systems; and

- Transportation choke points (e.g., bridges, airfields, ports, railway yards, etc.).

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[89] National Academy of Sciences—Committee on International Security and Arms Control, *The Future of U.S. Nuclear Weapons Policy* (Washington, DC: National Academy Press, 1997), p. 43.

[90] Similarly, 50 Russian cities containing 50 percent of the industry and 35 percent of the population could be obliterated by roughly 100 strategic nuclear warheads. Harold A. Feiveson, *The Nuclear Turning Point: A Blueprint for Deep Cuts and De-Alerting of Nuclear Weapons* (Washington, DC: The Brookings Institution Press, 1999), pp. 52–53.

[91] The US government released a similar list in the 1980s. See William J. Perry, under secretary of defense for research and engineering, Written response for the record, in Senate Armed Services Committee, *Department of Defense Authorization for Appropriations for Fiscal Year 1981*, 96th Congress, 2nd Session (Washington, DC: GPO, 1980), p. 2721.

While it is beyond the scope of this paper to weigh the detailed pros and cons of these alternative targeting strategies in practice, the United States has tilted strongly in favor of the latter since at least the 1970s for several reasons.[92] First, counterforce targeting offers greater flexibility and does not surrender escalation dominance to nuclear competitors.[93] In the event that an adversary launched nuclear strikes solely against US military forces, for example, the National Command Authority (NCA) would have the option of retaliating in kind, whereas, under a countervalue approach, they would be forced to choose between attacking population and industrial centers or yielding to the adversary's demands. Against an adversary that still retained an assured retaliatory capability against American cities, the NCA would likely be deterred from initiating such an exchange since the United States could not possibly secure an improved war outcome.[94]

Second, as Walter Slocombe observed in 1981 while serving as the Deputy Undersecretary of Defense for Policy Planning, the option of counterforce targeting strengthens deterrence by making it unmistakably clear to any would-be adversary that "in any course a nuclear war might take, they could never gain anything amounting to victory on any plausible definition of victory, or gain an advantage that would outweigh the unacceptable price they would have to pay."[95] Counterforce targeting also provides a hedge against the failure of deterrence in that US nuclear forces could be used to destroy a portion of an adversary's nuclear forces *before* they could be launched against the territory of the United States or its allies. As alluded to previously, the most significant drawback of a counterforce targeting strategy is financial—it requires substantially more nuclear forces to carry out than a countervalue approach.[96]

The Single Integrated Operational Plan (SIOP) for orchestrating a counterforce attack against the Soviet Union, for instance, reportedly included over 16,000 individual aim points as of 1986. However, it soon became clear that an excessive amount of targeting redundancy had accreted within the plan over time.[97] A full-scale review of the SIOP initiated in 1989 by Secretary of Defense Dick Cheney, and chaired by General Robert Herres, then vice chairman of the Joint

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[92] See Lawrence Freedman, *The Evolution of Nuclear Strategy* (New York: St. Martin's Press, 1983), pp. 331–92. For additional arguments in favor of counterforce targeting, see: Victor Utgoff, "In Defense of Counterforce," *International Security*, Spring 1982, pp. 44–60; Colin Gray, "Nuclear Strategy: A Case for a Theory of Victory," in *Strategy and Nuclear Deterrence*, ed. Steven Millet (Princeton, NJ: Princeton University Press, 1984), pp. 24–56; James Schlesinger, Press Conference of the US Secretary of Defense, January 10, 1974, at the National Press Club, Washington, DC as excerpted in *Nuclear Strategy, Arms Control, and the Future*, ed. P. Edward Haley and Jack Merritt (Boulder, CO: Westview Press, 1988), pp. 101–07; and Harold Brown, statement before the Senate Foreign Relations Committee on "Nuclear War Strategy, PD-59," September 16, 1980, as excerpted in *Nuclear Strategy, Arms Control, and the Future*, pp. 109–16. For a critique of counterforce targeting, see Desmond Ball, *Can Nuclear War Be Controlled?* Adelphi Paper No. 169 (London: International Institute for Strategic Studies, 1981).

[93] For a discussion of the concept of escalation dominance, see: Lawrence Freedman, *The Evolution of Nuclear Strategy*, p. 389.

[94] For a more in-depth discussion of this strategic conundrum, see Paul H. Nitze, "Deterring our Deterrent," *Foreign Policy*, Winter 1976–1977, pp. 195–210.

[95] Walter Slocombe, "The Countervailing Strategy," in *Strategy and Nuclear Deterrence*, p. 245.

[96] For arguments in favor of countervalue targeting, see Stansfield Turner, *Caging the Nuclear Genie: An American Challenge for Global Security* (Boulder, CO: Westview Press, 1997); and McGeorge Bundy, *Danger and Survival: Choices about the Bomb in the First Fifty Years* (New York: Random House, 1988).

[97] Industrial centers in Moscow, for example, had multiple warheads allocated to individual factories despite the fact that the buildings were closely clustered. Nearly forty weapons were designated to attack targets just in Kiev. See Nolan, *An Elusive Consensus*, pp. 28–31.

Staff, pared back the SIOP to some 10,000 targets by 1991.[98] Owing in large part to the phasing out of targets in Eastern Europe, by the time the next plan (SIOP-93) took effect in June 1992, the number of aim points had plummeted still further to about 6,000.[99]

This scaling down of the SIOP stalled until President Clinton signed Presidential Decision Directive 60 (PDD-60) in November 1997. PDD-60 shifted the focus of US strategic planning from fighting and winning a prolonged nuclear war with the Soviet Union, to deterring the use of nuclear weapons by credibly threatening a devastating response.[100] As Robert Bell, the former special assistant to the president for national security affairs, commented:

> Most notably the PDD removes from presidential guidance all previous reference to being able to wage a nuclear war successfully or prevailing in a nuclear war. . . . The emphasis in this PDD is therefore on deterring nuclear wars or the use of nuclear weapons at any level, not fighting with them.[101]

With this revision of US nuclear deterrence policy, combined with the modernization of the Strategic War Planning System (SWPS) used by US Strategic Command (STRATCOM), it became possible to cut to the Russian target set by more than half over the next few years.[102] (In addition, targets in the former Soviet nuclear republics of Belarus, Kazakhstan and Ukraine were also removed from the plan in 1997.)

Although the current SIOP has shifted away from preparing to fight and win a nuclear war with the Soviet Union, it remains heavily skewed toward a counterforce targeting strategy. According to recent leaks in the press, it currently encompasses about 2,260 vital strategic targets in Russia, including 1,100 nuclear sites, 500 conventional military installations, 500 defense factories, and about 160 leadership targets.[103] In addition, in 1998, a requirement for 500 additional warheads was incorporated to cover targets in China and so-called rogue states (e.g., Iran, Iraq and North Korea).

It is difficult to say precisely how many warheads would be required to reach an acceptable level of damage expectancy against this target set.[104] Since the damage expectancy of a single warhead

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[98] Hans Kristensen, *U.S. Nuclear Strategy Reform in the 1990s* (Berkeley, CA: The Nautilus Institute, 2000), p. 3. See also Nolan, *An Elusive Consensus*, pp. 29–30.

[99] Kristensen, *U.S. Nuclear Strategy Reform in the 1990s*, p. 4.

[100] Steven Lee Myers, "U.S. Updates Nuclear War Guidelines," *New York Times*, December 8, 1997, p. 1.

[101] R. Jeffrey Smith, "Clinton Directive Changes Strategy on Nuclear Arms," *Washington Post*, December 7, 1997, p. 1.

[102] Improvements in data processing made it possible to make the SWPS much more efficient and flexible, allowing for the creation of living SIOP that is constantly updated. See Kristensen, *U.S. Nuclear Strategy Reform in the 1990s*, pp. 3–7.

[103] Bruce Blair, "Cold War Era Assumptions Drive U.S. Nuclear Force Levels: Why the Target List Should Shrink," Coalition to Reduce Nuclear Dangers *Issue Brief*, vol. 4, no. 7, May 18, 2000; available at http://www.clw.org/pub/clw/coalition/briefv4n7.htm. See also Walter Pincus and Roberto Suro, "How Low Should Nuclear Arsenal Go," *Washington Post*, May 12, 2000, p. 4; and Bruce Blair, "START III, Nuclear War Plans and the Cold War Mindset," *The Defense Monitor*, Volume XXIX, 2000.

[104] Damage Expectancy = PK x PTP x PLS x PRE where PK = the probability of killing the target, which is in turn dependent on weapon yield, accuracy, height of burst, and target hardness; PTP = the probability of penetrating the

is less than 100 percent, STRATCOM typically allocates more than one warhead to high priority or extremely hard aim points such as missile silos and hardened, deeply buried command and control centers. For instance, nearly 400 highly accurate, high-yield warheads would be required to destroy, with high confidence, the 195 reinforced concrete silos that Russia retains under the terms of the START II Treaty.[105] The hundreds of deeply buried bunkers distributed throughout Russia would also require double targeting to reach a damage expectancy of over 90 percent. Conversely, a single warhead can be assigned to destroy multiple targets that are clustered within its effective radius. Taking these tradeoffs into account, Admiral Richard Mies, the present CINC of STRATCOM, has indicated that STRATCOM requires between 2,000 to 2,500 warheads to execute its deterrence and warfighting missions.[106]

Of course, one could argue that even a 2,260-element target set may be overly inflated given the ongoing deterioration of Russia's economy, conventional military forces and fielded nuclear forces. Putting that issue aside, the key question for our purposes is: how many of these 2,000-plus targets could be held at risk with emerging conventional precision-strike weapons and/or electronic-strike capabilities? Many of the conventional military installations, defense factories and leadership targets that are currently included in the SIOP, for instance, could be attacked with nonnuclear means. Indeed, the US attacked precisely these types of targets employing PGMs and electronic strikes in Iraq in 1991, 1996 and 1998; and in the Balkans in 1995 and 1999.

While it is impossible at this point to determine the precise number of strategic targets that could be reliably destroyed with nonnuclear means, a 10 percent substitution effect would seem to be well within the realm of feasibility at present.[107] If we assume that 10 percent of the targets could be removed from the current nuclear SIOP, the US nuclear arsenal could be reduced, unilaterally if necessary, to between 1,800–2,300 warheads.[108] For at least the next decade, this arsenal would also be more than sufficient for holding at risk strategic targets in China and small rogue states such as Iraq, Iran and North Korea.

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enemy's air and missile defenses; PLS = prelaunch survivability (probability that systems survive enemy preemptive actions); and PRE = the probability that systems function reliably. Theodore Postol, "Targeting," *in Managing Nuclear Operations*, ed. Ashton Carter et al. (Washington, DC: The Brookings Institution, 1987), pp. 379–81.

[105] START II allows Russia to keep 105 silo-based SS-19 ICBMs and to convert up to 90 SS-18 silos to house SS-27 ICBMs. SS-19 and SS-18 silos are probably capable of withstanding 5,000 pounds per square inch (psi) of peak blast overpressure from a nuclear detonation. Two 475-kiloton warheads, delivered with an accuracy of 500 feet circular error probable, would be required to achieve a 90-percent kill probability against each silo. The Mark 5 warhead on US Trident D-5 missile reportedly has these characteristics. See CBO, *Trident II Missiles: Capability, Costs, and Alternatives* (Washington, DC: CBO, July 1986).

[106] Bill Gertz and David Sands, "President Sticks to 2,000 Limit for Nuclear Arms Cuts," *Washington Times*, May 12, 2000, p. 1; Walter Pincus and Robert Suro, "How Low Should Nuclear Arsenal Go," p. 4; Bill Gertz, "Joint Chiefs Oppose Russian Plan to Cut 1,000 Warheads," *Washington Times*, May 11, 2000, p. 1; Eric Schmitt, "Pentagon Feels Pressure to Cut Out More Warheads," *New York Times*, May 11, 2000, p. 1; and Jonathan Landay and Steven Thomma, "U.S. Military Rejects Moscow Call to Cut to 1,500 Warheads," *Philadelphia Inquirer*, May 24, 2000, p. 1.

[107] Private interview with a senior defense official involved in strategic targeting issues.

[108] This range assumes a one-to-one correspondence between removed targets and warheads. Given that the removed targets would necessarily be relatively soft (i.e., not hardened, deep underground bunkers or missile silos), and thus, previously targeted by a single warhead, this ratio seems warranted.

Over time, however, competitors will likely attempt to reduce the effectiveness of nonnuclear strikes through a variety of means, including:

- Hardening and burying critical facilities;
- Widely disseminating increasingly sophisticated decoys to confuse US ISR systems;
- Exploiting mobility to complicate US targeting; and
- Protecting friendly information systems from electronic attack with firewalls, encryption and other means.

These offsets may prove much less useful as conventional precision strike and electronic warfare capabilities mature. In short, the outcome of this dynamic competition is unclear. The substitution effect noted above could increase several fold—or not at all—over the coming decades.

A different approach to sizing the residual nuclear forces leg of the new strategic triad would be to tie it to the warhead inventories of other nuclear powers (see Table 3 below). Looking toward the future, one could argue that the United States should retain enough warheads to guarantee numerical superiority relative to any likely hostile combination of nuclear-armed adversaries. For example, it might be prudent to maintain an arsenal equal in size to the combined nuclear forces of Russia and China. This approach would suggest a warhead floor that would start somewhere in the vicinity of 6,000 warheads and fall to less than 1,500 over the coming decade as Russia's deployed nuclear forces atrophy.

The problem with this approach is that it too closely links the nuclear posture of the United States to decisions made by foreign governments based on their particular strategic, political or economic situation. For instance, in the unlikely event that Moscow somehow managed to keep 6,000-plus nuclear warheads of questionable reliability in the field, the United States should not be compelled to follow lockstep by maintaining an arsenal of equivalent size. Conversely, if Russia's arsenal slips down into the low hundreds, which seems increasingly likely, it may not be prudent to reduce the US arsenal so drastically.

Table 3: Arsenals of Other Nuclear States as of 2000

Sources: This chart is based on multiple sources including the NRDC "Nuclear Notebook" articles and the Federation of American Scientists' (FAS) Website at www.fas.org. See Robert S. Norris and William Arkin, "Chinese Nuclear Forces 1999," *The Bulletin of the Atomic Scientists*, May/June 1999, pp. 79–80; "French and British Forces 1999," *The Bulletin of the Atomic Scientists*, July/August, pp. 77–79; "Russian Nuclear Forces 2000," *The Bulletin of the Atomic Scientists*, July/August 2000, pp. 70–71; and Ben Barber, "Pakistan's Nuclear Arsenal Underestimated, Reports Say," *Washington Times*, June 9, 2000, p. 1.

[a] Excludes use of indigenous space launch vehicles as a possible nuclear warhead delivery platform.

[b] Excludes some 8,000 warheads in reserve.

However, US nuclear force levels cannot be completely divorced from the nuclear programs of other states. A balance must be struck between tit-for-tat linkage and prudent responses to meaningful shifts in strategic balances. If other nuclear powers (e.g., a resurgent Russia or a rising China) embarked upon a large nuclear arsenal expansion program, the United States would, at some point, be compelled to build up its nuclear forces to retain a credible counterforce deterrent.

So how many residual nuclear warheads should the United States retain as part of the new strategic triad? In short, it depends. Assuming that the United States does not want to rely on a pure countervalue targeting strategy, it would appear that 1,500 warheads might well be, at present, a reasonable floor for the US nuclear arsenal. Given current projections related to the decline in Russia's strategic forces and China's ongoing nuclear force build-up, a warhead ceiling of about 3,000 warheads would be more than sufficient to balance them for at least the next decade.[109] Thus, residual nuclear forces in the new strategic triad might comprise somewhere between 1,500–3,000 warheads. Admittedly, that is a relatively large range. However, it is impossible to calculate a reasonable warhead level more precisely owing to the lack of sufficiently detailed, unclassified information on the targets sets in question (e.g., the hardness and defenses of specific aimpoints) and because of irresolvable uncertainty about the future strategic environment. Some of the key variables include the following:

- The rate at which Russia draws down its nuclear forces owing to economic pressures or START III entering into force, as well as the actual number of warheads that Russia is ultimately able to maintain;

- The pace of nuclear development programs in China, India and Pakistan, and their political disposition toward the United States and its allies; and

- The possible emergence of new nuclear powers with interests inimical to those of the United States such as Iran, Iraq and North Korea.

This range is broadly consistent with the parameters associated with current START III negotiations. As agreed to in Helsinki, the United States favors an aggregate warhead limit of between 2,000–2,500 warheads. More for economic than strategic reasons, Moscow would prefer to cut back to between 1,000–1,500 deployed warheads for each side. Table 4 (see below) depicts illustrative US nuclear force postures under a variety of warhead ceilings proposed for

[109] This is based upon a worst-case estimate for Russia of about 2,800 strategically deliverable warheads (see p. 9) plus 200 for China.

START III. A myriad of different force posture trade-offs could have been made. For example, at the 1,500-warhead ceiling, the traditional nuclear triad could be preserved by retaining one wing of 150 Minuteman IIIs in exchange for eliminating at least two additional SSBNs or 18 B-52 bombers. Below a floor of 1,500 warheads, however, it will become increasingly inefficient in terms of operations and maintenance costs to retain the traditional triad. It probably would not make sense, for example, to attempt to keep less than a single wing of Minuteman IIIs (about 150 missiles) or fewer than 48 nuclear-capable B-52s bombers in the field. As one Defense official commented, when "you start thinking about 1,500 or 1,000 [warheads] . . . You really are not, at that level, in the triad business anymore."[110]

Table 4: Illustrative US Nuclear Forces under START III

Sources: Based on multiple sources including William S. Cohen, *Report of the Secretary of Defense to the President and the Congress* (Washington, DC: GPO, 2000); and START I Memorandum of Understanding Data as of January 2000.

[a] Assumes 278 of 500 Minuteman III ICBMs are downloaded from 3 warheads to 1

[b] Includes 93 B-1Bs that are devoted entirely to conventional missions and will no longer be counted under START II.

[c] Total weapon count is closer to 3,500 but only 863 are counted. Under START I counting rules, the 16 nuclear gravity bombs with which the B-2 can be armed are only counted as one warhead. Similarly, while B-52s are counted as being armed with ten ALCMs each, they can actually carry up to 20.

[d] Assumes 21 B-2 stealth bombers armed with 16 nuclear gravity bombs each, 43 eight-warhead B-52H bombers (internal ALCMs) and 32 20-warhead B-52s (internal and external ALCMs).

[e] Assumes Trident D-5 SLBM downloaded to four warheads.

[f] Assumes 21 B-2 stealth bombers armed with 16 nuclear gravity bombs and 65 B-52s armed with eight internally carried ALCMs.

[g] Assumes Trident D-5 SLBM downloaded to three warheads, which would violate current START counting rules. Alternatively, the United States would probably be forced to eliminate at least two additional ballistic missile submarines.

At lower force levels, the issue of nuclear breakout—a rapid increase in one side's deployed nuclear forces—also becomes more of a concern. The START I and II agreements do not restrict the number of warheads that can be kept in reserve. Russia reportedly has about 8,000 warheads

[110] Adam Hebert, "For Bombers, Does START Equal Stop?", *Air Force Magazine*, October 2000, p. 26.

in reserve and as many as 20,000 disassembled warhead pits in long-term storage.[111] As a hedge against possible Russian breakout, the United States maintains an inactive reserve of some 2,500–3,000 refurbished warheads that could be rapidly uploaded onto existing strategic delivery systems. In addition, the US Department of Energy currently plans to maintain a national security reserve of plutonium, consisting of about 4,000 plutonium pits taken from dismantled warheads that could be turned back into useable weapons within about 18 months.[112] In addition to warheads, either side can also maintain non-deployed strategic delivery systems under the current START framework. For example, Russia has 50 mobile missile launchers and 54 missiles for the SS-25 ICBM system, three launchers and seven missiles for the rail-mobile SS-24 ICBM, and 166 other non-deployed ICBMs (96 S-17s, 41 SS-18s, and 29 SS-19s) that are excluded from START controls.[113]

These strategic loopholes must be closed to reduce the risk of breakout. At a START III ceiling of 1,500 deployed warheads, it would seem highly imprudent to allow Russia to maintain five times as many warheads in reserve, as well as over 200 non-deployed ICBMs, potentially armed with over 1,000 warheads. According to the US-Russian Joint Statement reached at the Helsinki summit in 1997, START III negotiations will address "measures relating to the transparency of strategic nuclear warhead inventories and destruction of strategic nuclear warheads" and other "technical and organizational measures to promote the irreversibility of deep reductions including prevention of a rapid increase in the number of warheads."[114] However, whether a START III agreement can be achieved that effectively addresses the breakout issue remains an open question. If the terms are insufficient to preclude breakout—which seems likely owing to verification constraints—then the prudent US course might be to accept this risk and make contingency plans and preparations for coping with this possibility.

What Kinds of Nuclear Forces Would Best Support the New Strategic Triad?

Aside from size, the residual nuclear force leg may also vary considerably in shape from its current configuration. To satisfy the requirement of credibly threatening strategic targets that cannot otherwise be disabled or destroyed by conventional precision-strike weapons or electronic strikes, it would be useful to repackage or redesign existing nuclear weapon systems to make them cleaner in terms of radioactive fallout, more flexible in terms of yield and more precise in terms of delivery. Increased precision would make it possible, for example, to rely on smaller-yield warheads that, if used, would cause significantly less collateral damage than today's high-yield strategic warheads. By making nuclear weapons more discriminate, and thus more politically useable, their deterrent value might actually *increase* in the eyes of would-be aggressors.

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[111] Walter Pincus, "Arsenal Cuts Don't Cover U.S.'s 12,000 Nuclear Triggers," *Washington Post*, April 16, 2000, p. 6.

[112] Ibid. The current number of pits in storage is actually 12,000, but 8,000 are slated for eventual removal from the reserve.

[113] Andrew Duncan, "START Cuts Begin to Make Their Mark," *Jane's Intelligence Review*, February 1999, p. 16.

[114] *Joint Statement on Parameters of Future Reductions in Nuclear Forces* from the Helsinki summit at http://www.usembassy.fi/whatshap/summit30.htm.

The nuclear bunker buster for most of the last forty years, the B53, had an explosive power equivalent to nine megatons of TNT. If used to destroy a hardened underground target it would blast a crater 500 feet deep, create a shock wave that would knock down wood-frame buildings up to six miles away, and spew lethal radiation in a pattern 50 miles wide by 100 to 200 miles long.[115] In contrast, its replacement, the newly-designed B61-11 has a dial-a-yield capability ranging from 300 tons to 300 kilotons of TNT, and by burrowing up to 50 feet into the soil before exploding, much of this destructive energy would be directed underground.[116] As a result, unlike its predecessor, the B61-11 would cause comparatively little damage on the surface. Blast damage would be limited to a radius of about one-half mile from the detonation point, and the radioactive fallout footprint would be almost two-orders of magnitude smaller than the B53's.

The ground shock caused by the detonation of a B61-11 is reportedly sufficient to destroy "a garden variety underground bunker" located beneath 100 meters of solid rock.[117] This is significant because a number of potential adversaries—including China, Iran, Libya, North Korea, and Russia —have "made extensive use of underground construction."[118] The diffusion of advanced, commercially available tunnel-boring machines has significantly increased the rate, lowered the cost and increased the sophistication of underground construction. There are machines available today that will bore a hole 50 feet in diameter and traverse 200 feet per day.[119] In short, given current trends in the construction of deeply buried facilities, several countries of concern will likely possess hardened bunkers located 300 or more meters below ground.

Consequently, from a purely military perspective, it may be necessary to develop a follow-on weapon to the B61-11 that can penetrate deeper into the ground before detonating or otherwise destroy the hardened and deeply buried targets that are likely to be increasingly prevalent within future strategic target sets. While it may be possible to remanufacture an existing warhead rather then completely redesign a new physics package, it would almost certainly be necessary to design a new bomb case that could withstand the shock induced by extremely high impact speeds. A critical question, however, would be whether cold tests of the assembled device (i.e., tests conducted without the nuclear warhead) would be sufficient to measure effectiveness reliably.[120] The alternative to conducting low-yield, underground tests would break the self-

[115] Matthew Wald, "U.S. Refits a Nuclear Bomb to Destroy Enemy Bunkers," *New York Times*, May 31, 1997, p. 1.

[116] Unlike the 9,000 pound B53, which was deliverable only by the aging B-52H, the B61-11 weighs only 750 pounds. and can be delivered by the B-2 and B-1B, as well as by multiple types of tactical aircraft, including the F-16C. See "U.S. Nuclear Bomb Passes Final Drop Tests," *Jane's Defence Weekly*, April 1, 1998, p. 5; and William Scott, "Test Drops of B61-11 Penetrator Weapon Continue," *Aviation Week & Space Technology*, June 9, 1997, p. 75.

[117] Walter Pincus, "Senate Bill Requires Study of New Nuclear Weapon," *Washington Post*, June 12, 2000, p. 2.

[118] Hearing on "Findings and Conclusions of the Commission to Assess the Ballistic Missile Threat to the United States," before the Committee on National Security, US House of Representatives, July 16, 1998, p. 38. See http://commdocs.house.gov/committees/security/has197000.000/has197000_1.htm.

[119] Ibid., p. 72.

[120] According to Stephen Younger, Associate Director for Nuclear Weapons at Los Alamos National Laboratory, "Given current and projected scientific capabilities, it is difficult or impossible to confidently field a new, highly optimized, nuclear weapons warhead design without nuclear testing." Younger argues that it might be possible, however, to rely on "gun-assembled or other simple, rugged designs that might be maintained with high confidence without nuclear testing" instead of today's highly optimized nuclear warhead designs. Stephen Younger, "Nuclear

imposed US testing moratorium that has been observed since 1992. While such tests could be invaluable in terms of validating new weapon designs, as well as ensuring the reliability of old ones, they would also violate the terms of the Comprehensive Test Ban Treaty (CTBT) that has been signed, but not ratified, by the United States.[121]

In their role as the ultimate guarantor of deterrence, residual nuclear forces must continue to pose a credible, second-strike capability vis-à-vis all likely combinations of nuclear-armed adversaries. This view was also espoused by the 1997 Quadrennial Defense Review, which concluded:

> The primary role of U.S. nuclear forces in the current and projected security environment is to deter aggression against the United States, its forces abroad, and its allies and friends. . . . In this context, the United States must retain strategic nuclear forces sufficient to deter any hostile foreign leadership with access to nuclear weapons from acting against our vital interests and to convince such leadership that seeking a nuclear advantage would be futile. Thus, for the foreseeable future, the United States will continue to need a reliable and flexible nuclear deterrent—survivable against the most aggressive attack. . . .[122]

The primacy of the deterrence mission was also re-affirmed by PDD-60, which asserts that "the United States must maintain the assured response capability to inflict 'unacceptable damage' against those assets a potential enemy values most."[123] The paramount force characteristic required for this mission is survivability, or the ability to ride out an adversary's first strike. At present, fleet ballistic missile submarines on patrol are considered to be largely immune from a preemptive bolt-from-the-blue strike because they are extraordinarily difficult to find. Taking advantage of an unlimited cruising range made possible by nuclear propulsion and the stealthiness inherent in operating underwater (electromagnetic radiation attenuates rapidly in water), SSBNs can hide in all the world's oceans. Therefore, assuming there are no radical breakthroughs in anti-submarine warfare (ASW), the nuclear warheads carried by submarine-launched ballistic missiles will remain very survivable.[124] Accordingly, a strong case can be made that they should increase in proportion to the other legs of the current triad as the overall warhead ceiling comes down. SLBMs could easily account for more than fifty percent of residual nuclear warheads within the new strategic triad.

In contrast, the number of fixed, land-based intercontinental ballistic missiles such as the Minuteman III, which are arguably the most vulnerable leg of today's triad, might be reduced,

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Weapons in the Twenty-First Century," p. 9. See also Adam Hebert, "Tactical Nuclear Weapons Losing Prominence in Air Force Planning," *Inside the Air Force*, September 8, 2000, p. 1.

[121] On October 13, 1999, the Senate voted down the CTBT by a vote of 51–48. A two-thirds majority is needed to ratify the accord.

[122] William S. Cohen, *Report of the Quadrennial Defense Review* (Washington, DC: Department of Defense, May 1997), Section III—Defense Strategy, p. 10.

[123] Warner, Statement to Strategic Forces Subcommittee.

[124] In a bolt-from-the-blue attack, approximately one-third of the SSBN fleet would likely be wiped out while in port. However, assuming that ten of the current 14 SSBNs survived, the SSBN fleet alone could retaliate with 240 highly accurate Trident D-5 SLBMs, carrying a total of 1,200 highly accurate, 475-kiloton yield warheads.

perhaps significantly. While there are some advantages to retaining ICBMs, they are more than outweighed by the survivability of SLBMs and the strategic flexibility of the bomber force, which can be placed on various stages of alert during peacetime as a signaling mechanism and can be recalled or re-tasked while in flight. [125]

IV. THE NEW TRIAD: KEY CONSIDERATIONS

ADVANTAGES OF THE NEW STRATEGIC TRIAD

Transitioning toward an increased reliance on nonnuclear strategic-strike capabilities could offer several major advantages over today's exclusive reliance on nuclear weapons. For one, strategic deterrence—including extended deterrence—might be enhanced. Deterrence must be based upon a *credible* threat to inflict costs on an adversary, sufficient to outweigh the possible benefits of some errant behavior. As discussed previously, the threat of US nuclear retaliation for enemy provocations short of a nuclear attack (e.g., chemical or biological strikes against the United States or an ally) stretches the bounds of credibility, especially against the growing number of states which possess the means to retaliate in kind. While there is unquestionably some deterrence value in not foreswearing the possibility of nuclear retaliation, potential adversaries would be far more likely to believe, and thus be deterred by, an unambiguous US threat to respond to a nonnuclear provocation with conventional and/or electronic strikes. According to one well-known analyst, the current policy of calculated ambiguity also makes it more likely that future US leaders will feel compelled to retaliate with nuclear weapons in response to a chemical or biological attack:

> The current doctrine presenting calculated ambiguity about possible nuclear weapons retaliation creates risks of a commitment trap, in which US leaders would feel compelled to use nuclear weapons after a biological or chemical attack because they believe that adversaries and allies perceive that the US reputation for honoring its commitments was at stake. Instead of the current doctrinal ambiguity, US leaders should state, loudly and often, that "the United States does not need to use its nuclear arsenal to punish any enemy who uses chemical or biological weapons against us or our allies. Our conventional weapons retaliation will be certain, swift, and devastating."[126]

Second, there may be benefits to having a nonnuclear strategic-strike capability in the event that deterrence of nuclear use fails. While it is certainly possible that the underlying presumption of non-use that held sway throughout the Cold War will continue to endure, policymakers must consider the real possibility that a rogue state, terrorist group or other irrational actor could detonate a nuclear weapon at some point in the future.[127] The relevant question would then

[125] Single-warhead Minuteman IIIs would provide more flexible targeting options than MIRVed SLBMs against widely distributed targets. Moreover, ICBMs arguably make an enemy first strike more challenging, or at least more resource intensive, because each hardened silo would need to be targeted with two or more warheads in order to achieve a sufficiently high level of damage expectancy.

[126] Scott D. Sagan, "The Commitment Trap," *International Security*, Spring 2000, p. 113.

[127] Fred Charles Iklé, former under secretary of defense for policy in the Reagan administration and director of the Arms Control and Disarmament Agency under President Ford, has expressed concern about precisely this

become how best to restore deterrence. The basic requirement for restoring deterrence is straightforward—the United States, together with like-minded countries, would have to demonstrate to the world community that the penalty for nuclear use is exceedingly high. Nuclear retaliation, of course, would serve this purpose rather well, but it would also further undermine the tradition of non-use. That is to say, a nuclear response to nuclear use may in fact work at cross purposes with the higher objective of re-establishing nuclear deterrence.[128] In contrast, nonnuclear strategic strikes could make nuclear renegades pay dearly for their errant behavior without undercutting the presumption of non-use.

Nonnuclear retaliatory options might also be preferred for political reasons such as coalition maintenance. For example, General Chuck Horner, based on his experience during Operation Desert Storm, stated, "I came to the realization that nuclear weapons had very little utility during the Gulf War, when I realized that even if Saddam Hussein used a nuclear weapon on us, we would have to retaliate on a *conventional* basis."[129]

Third, by adding a rung on the escalation ladder between conventional theater war and general nuclear war, a nonnuclear strategic-strike capability could provide US political leaders with a very valuable commodity during a period of crisis: flexibility. This rung could also act as a firebreak that might prove helpful in defusing an escalatory spiral to nuclear war. The decision to resort to nonnuclear strategic strikes against a nuclear-armed adversary's homeland would not only signal the seriousness with which US political leaders viewed a particular situation, but it would also make the escalatory path to a nuclear exchange unmistakably apparent for both sides—the unthinkable would suddenly become all too possible. Hopefully, this sobering realization would prompt both sides to step back from the brink.

Fourth, since a nonnuclear strategic strike would be far more discriminating than a comparable nuclear strike, it would also offer benefits in war termination. The effects of the former are likely to be far more easily reversed than those of the latter, and the prospect of a relatively rapid return to normalcy may substantially strengthen an adversary's incentives to cease hostilities. While it

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possibility. He has cautioned, in the event of nuclear use, "the end of the present era, in which nuclear weapons are plentiful but never used, would be sudden, and the major nuclear powers are ill prepared for the revolution in strategic thinking this event would compel." Fred Charles Iklé, "The Second Coming of the Nuclear Age," *Foreign Affairs*, January/February 1996, p. 119.

[128] Admittedly, however, under the exigencies of war, the long-term goal of re-establishing deterrence may be jettisoned in favor of defeating the enemy in the most expeditious manner possible. Interestingly, a recently conducted survey seems to indicate a public preference for precision conventional strikes rather than nuclear retaliation for WMD attacks. According to a careful University of New Mexico study, "When considering responses to attacks against the U.S., its troops, or its allies in which nuclear, biological, or chemical weapons are used, a majority of respondents indicated they would support the use of U.S. nuclear weapons to retaliate. However, when given three response options—diplomacy only, conventionally armed 'smart bombs,' or nuclear weapons—respondents overwhelmingly favored 'smart bombs' for responding to biological or chemical attacks against U.S. forces, and a plurality (46 percent) favored 'smart bombs' over nuclear weapons for responding to a nuclear attack against US forces. . . . [T]hese findings indicate that participants placed considerable value in precision guided munitions for both deterrence and for retaliation should deterrence fail, but that they would support nuclear retaliation under some circumstances." Kerry G. Herron, Hank C. Jenkins-Smith and Scott D. Hughes, *Mass and Elite Views on Nuclear Security: U.S. National Security Surveys, 1993–1999, Vol. I: General Public* (Albuquerque, NM: University of New Mexico Institute for Public Policy, June 2000), p. x.

[129] Emphasis added. "Questioning Nuclear Arms."

might take a few years to rebuild and recover from nonnuclear strikes, the radioactive contamination caused by a nuclear exchange could easily preclude reconstruction for decades.

Fifth, given the funding shortfalls of the Clinton Administration's defense program, maintaining a larger than necessary nuclear force posture incurs substantial opportunity costs that impede efforts to improve US military capabilities in areas where real shortfalls exist (i.e., in creating a different kind of strategic-strike capability). Reducing the current US strategic nuclear forces to START II levels would save some $6 billion over the next seven years.[130] Reducing below START II levels to 2,000 warheads could save as much as an additional $2 billion per year through 2010 if the United States were to implement the reduction by, for example, cutting an additional four Trident ballistic missile submarines and 300 Minuteman ICBMs.[131] Further cuts to the 1,000–1,500 level could realize still more significant savings.[132] Eliminating the ICBM leg of the triad, for instance, could generate over $10 billion in savings over the next decade.[133] These savings could be used to make a major contribution to the development and procurement of a strategically significant quantity of conventional precision-guided weapons or electronic-strike capabilities. To put these figures in practical terms, $15 billion in savings could be used to procure around 20,000 extended-range, precision-guided cruise missiles over the next decade.

Lastly, by transforming its strategic-strike forces in a way that devalues nuclear weapons, the United States *may* encourage other advanced military organizations to do the same. The transformation to a new, more balanced strategic-strike triad would also likely reap some political benefits by strengthening the Nuclear Nonproliferation Treaty (NPT), which obligates the nuclear powers to reduce their nuclear forces, with the ultimate goal of eliminating them. As recently as the sixth review of the NPT in May 2000, Britain, China, France, Russia, and the United States re-affirmed their "unequivocal commitment to the ultimate goal of a complete

[130] This includes $5.2 billion associated with maintaining 18 rather than 14 Trident ballistic missile submarines in service, and $550 million associated with keeping 50 MX missiles in service rather than retiring them. General Eugene E. Habiger, former commander in chief, US Strategic Command, Interview with Defense Writer's Group, Washington DC, March 31, 1998. Under language inserted in the FY 2000 Defense Authorization Act, the President is prohibited from reducing nuclear forces to START II levels, except that he may reduce the size of the Trident fleet from 18 to 14 boats if he certifies, among other things, that doing so will not decrease the effectiveness of the US strategic deterrent. Most of these savings are apparently already assumed in the Administration's latest plan, since it assumes the retirement of four Trident submarines. CBO, "Budget Options for National Defense 2000," March 2000, p. 40. Available on-line at:
www.cbo.gov/showdoc.cfm?index=1873&sequence=0&from=1

[131] This estimate was derived based on a number of different sources, including the CBO, "Estimated Budgetary Impacts of Alternative Levels of Nuclear Forces," March 1998; CBO, letter to the Honorable Jesse Helms, May 4, 1995; and CBO, *Preserving the Nuclear Weapons Stockpile under a Comprehensive Test Ban* (Washington, DC: CBO, May 1997). The largest savings would result from buying fewer Trident II missiles, avoiding the cost of backfitting early Trident submarines to accommodate the Trident II missile, reduced operations and support costs due to the smaller number of ICBMs and submarines in the force, and lower Department of Energy costs resulting from a smaller warhead stockpile requirement.

[132] See Andrew F. Krepinevich and Steven Kosiak, "Smarter Bombs, Fewer Nukes," *Bulletin of Atomic Scientists*, November/December 1998, p. 30.

[133] Assumes annual operation and support cost for Minuteman III at $1.9 million per missile and $3.2 million per missile for the MX. These estimates, adjusted to present-day dollars, are based on data generated by the CBO. See CBO, "The START Treaty and Beyond," October 1991, p. 140. The Air Force claims it spent $282.5 million maintaining the MX and Minuteman III arsenal in 1999, not counting the salaries of uniformed personnel and other indirect costs. George Wilson, "Start by Scrapping the Blockbuster Missiles," *National Journal*, May 27, 2000, p. 1702.

elimination of nuclear weapons."[134] Shifting to a strategic-strike triad that is less reliant on nuclear weapons would lend credence to this US pledge.

POTENTIAL DOWNSIDES OF THE NEW STRATEGIC TRIAD

There are several *potential* disadvantages associated with this new type of strategic triad, however, which warrant careful study. First of all, as previously mentioned, conventional precision-strike and electronic-strike weapons will probably be incapable of reliably disabling *all* classes of strategic targets. For instance, with the possible exception of kinetic-energy penetrators released from space, currently envisioned PGMs will not be able to approach the effectiveness of nuclear weapons in disabling super-hardened, deep-underground command-and-control nodes, missile silos and storage facilities for WMD. This is particularly problematic because, as the most recent *Annual Report to the President and the Congress* from the Secretary of Defense notes, "several rogue states are making serious efforts to move important military and industrial facilities underground."[135] In short, the extent to which nonnuclear strike capabilities can substitute for nuclear weapons is not boundless and needs to be carefully assessed. To complicate matters, the tradeoff between the two is dynamic; it will change over time as conventional- and electronic-strike systems mature, as the strategic target set evolves, and as offsets are developed to dilute the effectiveness of nonnuclear strategic-strike forces.

Second, there is also the danger that the development of an effective nonnuclear strategic-strike capability by the United States—because it would appear to be much more useable than a nuclear strike capability—could *increase* the incentives for potential adversaries to acquire at least a small nuclear arsenal for deterrence purposes. The objective would be to have their homeland, or at least some portion of the strategic targets within it, accorded sanctuary status. This may be especially true with less developed countries, which may view the acquisition of a substantial conventional strategic-strike capability as well beyond their means and view nuclear weapons as a relatively cheap, albeit primitive, counter to nonnuclear strategic-strike operations. As India's former Army chief of staff, General K. Sundarji, commented following Operation Desert Storm in 1991, "The Gulf War emphasized again that nuclear weapons are the ultimate coin of power. In the final analysis, they [coalition members] could go in because the United States had nuclear weapons and Iraq didn't."[136]

Robust strategic precision-strike and electronic-strike capabilities could also destabilize nuclear deterrence. The lethality of these new weapons could call into question the survivability of the nuclear deterrent arsenal of other states. Even if China doubled its current inventory of 20 ICBMs, Beijing might view them as increasingly vulnerable to a disarming *conventional* attack by the United States. This fear could be heightened if the United States eventually fields a limited NMD system because it could potentially intercept those few missiles that survived a

[134] Michael Evans, "Nuclear Powers Pledge to Work toward Disarmament," *London Times*, May 2, 2000, p. 1.

[135] William S. Cohen, *Report of the Secretary of Defense to the President and Congress (2000)*, (Washington, DC: GPO, 2000) p. 40

[136] Dr. Keith Payne, Statement before the Subcommittee on Strategic Forces, Senate Armed Services Committee, Hearing on Strategic Nuclear Deterrence, March 31, 1998. See also Brigadier VK Nair, *War in the Gulf–Lessons for the Third World* (New Delhi, India: Lancer International, 1991).

conventional US first strike. Spurred on by this strategic concern, Beijing may opt to build up its nuclear forces even more than would otherwise be the case.[137] However, a low-level arms competition with China may be an acceptable military, economic and political cost of US acquisition of substantial nonnuclear strike capabilities. For the foreseeable future, it would be a competition in which the US could easily maintain the lead.

As its nuclear forces dwindle over the next decade, even Russia may begin to view US nonnuclear strategic-strike capabilities with some trepidation. There are already signs of this occurring. One Russian military analyst recently cautioned that US exploitation of information and precision-strike technologies may "soon make it possible to launch a destructive [conventional] strike against Russia's strategic forces, thereby depriving Russia of any significant capability whatsoever for launching a counter strike against facilities located on US territory."[138] Whether the United States could, in fact, conduct such an attack successfully is less important than the perception that it might be possible. Some might argue that, in a crisis, this uncertainty could foster a use them or lose them mentality that could make escalation to nuclear use more likely. However, this fairly mechanistic view of crisis stability is hardly credible. In the event that the United States opted to target Russian nuclear forces with conventional weapons in a future conflict, it is hard to imagine that leaders in Moscow would escalate to nuclear use knowing full well that the United States would unquestionably retaliate in kind. Escalating to nuclear use in a crisis would only be attractive if there was a reasonable chance of being decisive; however, in this case, it would be tantamount to suicide.

Fourth, while technologies are currently being developed to enhance conventional bomb damage assessment, obtaining accurate information about the results of precision strikes will probably continue to be difficult. Generating dependable BDA for electronic strikes is, and will likely remain, even more problematic. In many cases, successful electronic strikes will not generate any directly observable signatures. By contrast, assuming they detonate properly, nuclear weapons leave comparatively little doubt about whether the target has been disabled.[139] Moreover, since an adversary's ability to defend against computer network attacks will be shrouded in secrecy during peacetime, it will probably be difficult to gain a reliable assessment of the likely effectiveness of electronic strikes for planning purposes. As a result, the planning and orchestration of an electronic strategic-strike campaign will likely be fraught with uncertainty. The synergistic effects of conventional and electronic attacks would likely add another level of complexity to campaign planning and assessment.

Although conventional PGMs and electronic-strike systems will be developed and produced in quantities sufficient for fighting in one or two major regional contingencies, they could be

[137] A National Intelligence Estimate released in the late summer of 2000 reportedly concluded that construction of a US missile defense system would cause China to significantly accelerate its production of nuclear weapons beyond current plans, expanding its arsenal to as many as 200 warheads deliverable against the continental United States. Roberto Suro, "Study Sees Possible China Nuclear Build Up," *Washington Post*, August 10, 2000, p. 2.

[138] Article by Vitaly Tsymbal in the Russian journal *Yaderny Kontrol* (Nuclear Control), as quoted in Mike Moore, "Unintended Consequences," *The Bulletin of the Atomic Scientists*, January/February 2000, p. 62.

[139] Interestingly, during the Cold War, nuclear targeting only took into account the *immediate* effects of a nuclear strike, and not uncertain secondary effects such as fire, fallout and persistent radioactive contamination. See Nolan, *An Elusive Consensus*, p. 30.

rapidly depleted during non-strategic operations.[140] Since the size of the inventory could fluctuate widely, it would provide an unsuitable foundation for strategic deterrence. In the interest of stability, it would be far more preferable to amass a separate *strategic* reserve of conventional and electronic-strike forces. The cost associated with building up a reserve large enough to supplant part of the existing nuclear arsenal, however, would be substantial. Nuclear weapons are simply more efficient than conventional PGMs, particularly with respect to destroying large area targets such as ports, airfields, storage depots, industrial complexes, and other high-value military installations. As a result, depending on the proportion of such targets in the future strategic target set, it would probably be necessary to procure hundreds of PGMs for every nuclear warhead replaced. For example, in the case of area targets, replacing 500 nuclear warheads assigned to relatively soft targets with a functionally equivalent number of precision-guided munitions could easily cost tens of billions of dollars.[141]

Another possible downside to reduced reliance on nuclear weapons is that it could lower the entry barrier to nuclear superpower status. For instance, it would not be in the US interest to lower its nuclear arsenal unilaterally to the point that China, France, India, Israel, and Pakistan could easily become de facto nuclear peers. Nor would it be prudent to so outpace Russia in reducing our inventory that a disarming nuclear first strike against US strategic forces (both conventional and nuclear) becomes even a remote possibility.

Finally, there is the chance that this type of strategic triad could make both conventional and nuclear conflict *more* likely by making the consequences of engaging in strategic warfare appear more palatable. It can be argued that the willingness of nuclear-armed states to engage in conventional conflicts with each other has been throttled in the past by the prospect, however slight, that escalatory pressures or misperceptions might trigger a nuclear war. By reducing the perceived risk of nuclear conflict by interposing the option of nonnuclear strategic warfare, it is possible that conventional wars may actually become more frequent. As a result, the risks of inadvertent escalation to nuclear weapon employment may increase. As one well-known strategic analyst has observed:

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[140] The issue of depletion was raised with respect to US military operations against Iraq in November 1998. Before the commencement of Operation Desert Fox, Air Force leaders were apparently concerned that a proposed strike on Iraq would consume 30 percent of their stock of long-range precision weapons (conventional air-launched cruise missiles), creating a severe shortage that could not easily be replaced in the event of another conflict. Despite these concerns, however, the Air Force did indeed expend 90 of the 300+ CALCMs in its inventory. Similarly, the Navy expended nearly 10 percent of its inventory of Tomahawks, or 325 out of approximately 3,400 missiles. David A. Fulghum, "Tricks Panicked Iraq, Triggered Agreement," *Aviation Week & Space Technology*, November 23, 1998, p. 29. See also Linda Kozaryn, "Four Nights: 100 Targets," *American Forces Information Service*, December 21, 1998. The current size of the CALCM and Tomahawk inventories is based on data obtained from the Federation of American Scientists, see http://www.fas.org/man/dod-101/sys/smart/index.html. Another, older example of depletion concerns can be found during the Korean War. Although B-29s saw action in that conflict, Curtis LeMay, the CINCSAC at the time, was unwilling to send front-line bomber units because, in his words, "I did not want to destroy the capability that we had built up for a strategic war if we had to go to war." *Strategic Air Warfare: An Interview with Generals Curtis LeMay, Leon W. Johnson, David A. Burchinal, and Jack J. Catton*, ed. Richard H. Kohn and Joseph P. Harahan (Washington, DC: GPO, 1988), p. 87.

[141] Assumes 500 area targets (e.g., airfields, ports, military installations) x 100 precision guided missiles per target x $500,000 per missile (current production unit cost for the TLAM) = $25 billion. Furthermore, this rough cost estimate does not reflect the expense of the delivery platform required to get the missile into range of the target, nor does it take into account operations and maintenance fees associated with the missile and its delivery system.

> Trading nuclear war for conventional war would be a tempting bargain except for escalation. If we allow the risks of conventional conflict to increase by making nuclear conflict less credible, then through the backdoor of escalation, the net effect may be perverse: it may ultimately increase the risks of nuclear conflict.[142]

THE NUCLEAR SHADOW

For half a century, nuclear weapons have been associated with conducting strategic warfare against an enemy's homeland. Now, with the possibility that a military revolution will see conventional precision weapons, and perhaps electronic-strike weapons as well, that can disable or destroy strategic targets more discriminately than their crude ancestors, some may ask whether nuclear weapons will become obsolete, a casualty of this military revolution.

This seems highly unlikely. In fact, nuclear weapons seem likely to exert a strong and enduring influence on warfare, casting a long shadow over humankind even after the emerging military revolution reaches its mature stage in the early decades of the new century. In short, the future conflict environment, while radically different from what was experienced in the late Cold War period, will still find military forces operating under a nuclear shadow, or overhang.[143]

There are several reasons why nuclear weapons will continue to exert a strong and enduring influence on military competitions and the conduct of war. First, as noted above, although precision-strike weaponry will be able to substitute for nuclear strikes, this substitution effect will not be comprehensive. Would-be adversaries can also be expected to explore ways for offsetting even a limited nonnuclear strategic-strike capability.

For example, in testimony before Congress in 1998, the current Secretary of Defense, Donald Rumsfeld, remarked that China, Iran, North Korea, and Russia many other countries have already "made extensive use" of underground construction.[144] Precision weapons were fabricated on short notice during the Gulf War for attacking underground bunkers and shelters, and now the Air Force and Navy are working on improved penetrators to counter the effects of target hardening.[145] However, it seem unlikely that enhanced PGMs will be able to overcome determined efforts by competitors to offset them by burrowing deeper and applying additional protective layers.

Both of the leading alternatives for destroying such targets carry heavy political baggage. One involves the development of low-yield, high-precision nuclear weapons. The other option would employ conventional precision munitions de-orbited from space, where the extremely high velocity generated on re-entry into the atmosphere would produce sufficient kinetic energy to

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[142] Carl H. Builder, "Why Not First-Strike Counterforce Capabilities?" *Strategic Review*, Spring 1979, p. 3.

[143] Vickers, *Warfare in 2020*, p. 13.

[144] Hearing on, "Findings and Conclusions of the Commission to Assess the Ballistic Missile Threat to the United States," p. 74.

[145] Department of Defense, *Conduct of the Persian Gulf War* (Washington, DC: Department of Defense, April 1992), pp. 165–66; and "Hard-Hitting Tomahawk to Fly by 2002, Says USN," *Jane's Defence Weekly*, February 4, 1998, p. 4.

destroy some underground shelters.[146] Fully developing either of these options, however, could encounter formidable domestic political opposition, in addition to triggering strong protests from the international community. A third option might be to neutralize these facilities with electronic means.

Perhaps the most elegant solution to the challenge would be to pursue an indirect approach to neutralizing deeply buried, hardened targets. By viewing the enemy strategic target base holistically, as opposed to taking a reductionist view and examining targets individually, it may be possible to negate the effectiveness of hardened targets through the second- and third-order effects of neutralizing other targets. For example, although PGMs may not be able to defeat a hardened command and control bunker, the bunker's effectiveness may be negated by severing the bunker's communications links or its power supply. Thus targets that might not be viewed at first as part of the enemy's strategic target base—individual fiber optic lines or power stations, for example—may be included because of the second-order effects that can be obtained with their neutralization. Given the difficulties involved in determining second and third-order effects in advance of executing strategic strikes, and in measuring the effectiveness of such strikes after they have been undertaken, the effect could be to shift the challenge from developing PGM hard-target penetrators to realizing a very high degree of precision in characterizing the strategic target base and in conducting battle damage assessments.

Second, nuclear weapons will likely prove irreplaceable to major powers as instruments of assured destruction of the enemy homeland. Conventional precision strategic strikes, by virtue of their high accuracy and relatively low yield, produce comparatively little prompt, widespread damage against a society's population and economic infrastructure. Although such strikes might be able to bring a modern information state to its knees by disabling critical infrastructure nodes, the loss of life and property would likely be nowhere near as immediate, devastating and irreversible as that caused by a nuclear attack against the same target set.

As such, nuclear weapons will continue to exert a dampening effect on military operations, particularly strategic strikes, whether they be conventional, electronic, nuclear or a mix of all three. Indeed, those states possessing a robust nuclear deterrent might expect to see their homeland accorded status as a strategic sanctuary, not only from nuclear strikes, but perhaps from all forms of strategic strikes. That is not to say, however, that nonnuclear strategic exchanges between nuclear-armed adversaries are unthinkable, for instance between India and Pakistan. As alluded to previously, possession of nuclear weapons could provide the attacker with the strategic backstop necessary to launch such strikes without undue fear of nuclear retaliation. Knowing full well that the attacker had a secure arsenal of nuclear weapons, the victim of a precision-strike barrage would have only two practical options: retaliating in kind or not at all. In either case, both sides would be under enormous pressure to keep escalatory pressures in check. In most circumstances, therefore, nuclear-armed adversaries would probably gravitate toward proxy wars, embargoes, blockades, and other less threatening instruments of military coercion.

[146] US Air Force Scientific Advisory Board, *New World Vistas*, p. 83. The Board notes that "With the application of a small boost rocket . . . these munitions are able to deorbit autonomously or on command, and guide via GPS to a precision strike at hypersonic velocities essentially anywhere on the earth. The extended rods of these munitions would be able to penetrate hundreds of feet into the earth to destroy hardened bunkers or other buried facilities."

As ever-greater destructive power is placed in the hands of individuals, it may be possible to undertake an irregular or unconventional strategic-strike campaign. Chemical or biological agents, and perhaps even nuclear weapons, could be employed by small teams against selected strategic targets in such a way that the links between these irregular units and any state sponsors would be difficult, if not impossible, to establish. Unlike state actors, such irregular groups would offer no clear target set against which to retaliate. At the same time, such attacks could achieve strategic effects. For example, if several US subway systems were subjected to WMD attacks by an independent group opposing US military action in a major regional conflict, it could deter the United States from deploying forces to protect its interests in the threatened region. Similarly, electronic strikes, which could be difficult to trace back to a state actor, could wreak havoc with critical US information infrastructure. The United States, by virtue of being an open society and the first state to make the transition from an industrial economy to an information-based economy, may be at a severe competitive disadvantage against this kind of strategic strike.[147]

Third, while nuclear weapons may be substantially displaced in advanced militaries, they will remain, in the eyes of less-advanced militaries, a relatively cheap, albeit primitive, counter to conventional precision strategic-strike operations. At least over the near- to mid-term, future prospective competitors will almost certainly trail the US military in effecting the transformation to a new strategic-strike triad. They may desire to develop alternatives to nuclear weapons, but may have neither the fiscal resources nor the technical competence to do so. Thus, the military revolution may have the perverse effect of encouraging nuclear (and other WMD) proliferation as the counterrevolution in military affairs.

Fourth, humankind cannot disinvent nuclear weapons. The knowledge of how to fabricate these weapons is now widespread. We can hope that the disincentives for states to acquire nuclear weapons remains high, but as we see today with respect to India and Pakistan, incentive structures and intentions can change rapidly. Thus while movement toward much lower levels of nuclear weapons may be both desirable and strategically sound, at some point (perhaps when these weapons number less than 1,000) it will likely prove very difficult to engage in further reductions because of the risk of nuclear breakout.

[147] National Defense Panel, *Transforming Defense*, p. 26.

V. AN ASSESSMENT FRAMEWORK

How might one assess the implications for the United States of a transformation in strategic-strike capabilities? A detailed examination of the question is beyond the scope of this paper. However, a first-cut at developing a structure for such an assessment is possible. The framework provided below is intended to serve as a point of departure for a net assessment of the emerging new regime in strategic strike. The reader is cautioned that, although the transformation of strategic strike may lead to nonstate actors playing a significant role, the following discussion focuses principally on the competition between states. Moreover, the focus here is on developing a diagnosis of the future security (or competitive) environment, as opposed to outlining a strategy (or prescribing a set of actions) for the United States to pursue.

Among other things, in charting a course for the future, the United States should take into account both the prospective character of the military competition in the post-transformational strategic-strike regime, and the competitive dynamics of the transformation period itself, to include the participants' objectives. Methods to assess the strategic-strike military balance will have to be developed, along with the appropriate analytic measures, or measures of effectiveness (MOEs). Enduring sources of competitive advantage and disadvantage should be identified. The process should also address the key asymmetries existing between competitors that may exert a major influence on the competition and the military balance.

US OBJECTIVES

The principal US objectives in a post-transformational strategic strike (i.e., nuclear, precision, electronic) would likely include:

- Deterring strategic strikes, in their multiple forms, on the US homeland;
- Deterring strategic strikes and other acts of overt military aggression against US allies and friends (i.e., sustaining the strategic deterrence umbrella);
- Retaining the ability to respond flexibly to achieve US security objectives in the event deterrence of strategic strikes fails;
- Preventing inadvertent escalation to nuclear weapons use by either the United States or its adversaries;
- Defeating rapidly acts of regional or local aggression *not* involving the use of nuclear weapons through nonnuclear strategic strikes;
- Discouraging prospective competitors from entering into a competition with the United States in strategic-strike capabilities; and
- Discouraging prospective friendly competitors (e.g., allies) from developing the nuclear component of the strategic-strike triad.

A New Competitive Environment

The Cold War strategic-strike regime comprised two nuclear superpowers and several relatively minor nuclear powers. While precision and electronic strike seem likely to exert some form of substitution effect for nuclear weapons, the precise characteristics of a post-military transformation regime cannot yet be described with any degree of precision.

For example, the post-transformation regime could be characterized by a larger number of nuclear powers, or by roughly the same number that exist today. Unfortunately, recent nuclear proliferation trends are less than encouraging. Both India and Pakistan have recently tested nuclear weapons and are now openly fielding nuclear forces. Other states such as Iran and North Korea are apparently pursuing a nuclear capability. Thus it is not implausible that the emerging strategic-strike regime, a decade or so from now, could be populated by a dozen or so nuclear powers.

As for the second leg of the new strategic triad, at present, only the United States has large precision-strike forces. Although, if history is any guide, the other major powers will attempt to follow the United States in developing both precision and electronic/information-strike capabilities.[148] Since the technological and fiscal barriers to entry are relatively low, the precision revolution is likely to be more democratic than the nuclear revolution over the long run. However, developing a world-class precision-strike force will require substantial resources, to include not only the munitions and their delivery systems (e.g. aircraft, missiles), but also the well-trained personnel, operational experience and a well-developed C4ISR capability needed to realize the full value of such a force.

The information revolution is likely to be even more accessible, with many states developing some capability for conducting electronic strikes at the strategic level of warfare. Indeed, the ability to conduct such strikes is likely to diffuse beyond regional rogue states to include irregular forces, terrorists and other nonstate actors. In summary, over the next two decades it seems likely that regional rogue powers on the scale of an Iran, Iraq or North Korea will possess the means for field a poor man's version of the new strategic triad, should they choose to do so.

The Transformation Threshold

At what point does the introduction of precision-strike and electronic-strike capabilities achieve the critical mass needed to wage a credible strategic-strike campaign or achieve a significant displacement of nuclear weapons? Clearly a few dozen PGMs and a primitive C4ISR capability would not disrupt the existing regime, but what would? No easy answer to this question is forthcoming as it depends on myriad factors, many of which will probably become apparent only over the next decade or so. Among these factors are: geography, strategic posture and related doctrine, geopolitical relationships, the rate of technological progression and diffusion (to include the development of effective defenses), the strategic cultures of competing militaries, and the ability of military organizations to recognize the potential to create a new strategic-strike

[148] For example, Great Britain's naval competitors quickly followed the Royal Navy in constructing *Dreadnought*-class battleships, the strategic systems of their day, just as the great powers moved with relative speed to develop nuclear weapons once the United States possessed them.

regime and to act upon it.[149] The United States' competitive position, to include its strategic-strike doctrine and forces, will be greatly influenced by these factors.

Put another way, the timing and character of the transformation will likely be situational. Consider a historical example. The German Army that entered World War II proved capable of overwhelming Poland in four weeks and overrunning France and the low countries in six weeks, while executing a new form of mobile, air-land mechanized warfare that came to be known as blitzkrieg. It is unlikely that Germany would have possessed this kind of military capability had not Adolph Hitler radically altered the country's security objectives in the mid-1930s. The force that was created was ideally suited for the immediate task at hand: defeating Germany's two most threatening neighbors: France and Poland. However, Germany's blitzkrieg method of warfare proved ineffective for conquering Great Britain, due in large part to the offset provided by the English Channel. Germany's war machine also foundered against the Soviet Union, which presented a problem of scale; it proved simply too big to conquer with the resources available to Germany.

In a similar manner, post-transformation strategic-strike forces may also see their effectiveness vary considerably depending upon the situation, or contingency, in which they are used. For example, against a regional great power possessing substantial new triad forces, the United States' strategic-strike forces' principal utility may be in deterring an attack on the US homeland in exchange for according the enemy state's homeland sanctuary status (in much the same way that China and the Soviet Union were sanctuaries from US attack during the Korean War). The same US force might be able to effect the rapid defeat of a regional rogue state possessing little or no new triad forces by employing nonnuclear strategic-strike forces and missile defense forces. Yet the same US force might be incapable of effectively deterring or defeating large-scale electronic attacks on the US homeland by irregular forces operating independently of any state sponsorship. Thus capabilities that are highly valued in some situations may be far less effective, if they are effective at all, in other situations. In summary, strategic-strike operations are not likely to offer any more a panacea for US security concerns than they did in the day of Douhet and Mitchell, or the period of massive retaliation.

If the post-transformation competitive environment is shrouded in uncertainty, so too is a sense of how the *transformation* to the new strategic-strike regime will proceed. We know the United States has an early, dominant lead in precision- and (probably) electronic-strike forces. But we do not know how many other competitors will develop these capabilities. Nor do we know how quickly they will do so, or the form and scale their precision/electronic-attack capability might take[150] (i.e., the role such forces would play in achieving political goals, the mix of capabilities and systems, how they would be organized, and what their concept of operations might be).

[149] Again, this paper assumes that over the next decade or so, progress toward the development of defenses against nuclear and precision strike will not be sufficient to create a defense-dominant regime (i.e., a regime in which it is substantially easier to defeat such an attack than to mount it).

[150] Imperial Japan, for example exploited the same basic technologies that supported Germany's blitzkrieg—aviation, mechanization and radio—and adapted them to its own situation by creating its aircraft carrier task forces.

Technical uncertainty must also be considered. It is difficult to state with high confidence what new precision-strike and electronic-attack capabilities may be developed, when they will be developed or how quickly they will diffuse. Nor is it clear how quickly or effectively such new capabilities might be countered, or offset, by a combination of capabilities and operational concepts. This latter point refers, in part, to the development of effective defensive counters, such as missile defenses and armor-plating information systems against electronic attack. The interplay of these and other factors, may produce a series of brief transitory strategic-strike regimes, somewhat similar, for example, to the mini-regimes or intra-regime shifts that marked the transformation of maritime warfare in the period between the two world wars.[151] Similar shifts might occur during the transformation to a new strategic-strike regime. Any attempt to assess the character of competition during the transformation to a new strategic-strike regime must take into account these uncertainties. Moreover, any strategy based on such an assessment should identify ways to reduce uncertainty where it is possible and hedge against uncertainty where it is not.

Transformational Dynamics: Preliminary Considerations

As noted above, the transformational dynamics involved in moving from the current strategic-strike regime to the post-transformational regime must be considered. Some key issues that might be included for assessment are:

- *What competitive advantages (if any) are derived by the United States having the first military to effect a transformation in strategic-strike capabilities?* For example, would a US shift in emphasis away from nuclear weapons and toward precision and electronic strikes devalue nuclear weapons in the eyes of prospective competitors or increase their attractiveness? Would it discourage competition in strategic-strike capabilities or stimulate it?

- *What kinds of entry and exit barriers will exist for competitors in moving along the transformation path, and what competitors are best positioned to surmount them?* Entry barriers to transformation could be technological (e.g., developing HPM and EMP weapons); political (e.g., treaties proscribing the weaponization of space; the inability, thanks to various technology control regimes, to outsource transformation by acquiring key components of the new triad from external suppliers); and fiscal (e.g., insufficient resources to develop or support all elements of the new triad). Exit barriers might include the existing defense capital stock (whose purchase often must be justified by maintaining systems to the end of their planned life cycles), bureaucratic inertia, and continued reliance on outdated analytic tools and measures of effectiveness for evaluating new capabilities.[152]

[151] During that time, naval aircraft were initially effective in enhancing the performance of the battle line. Then their capabilities as a raiding force emerged. This was followed by carrier-based aircraft becoming a dominant means for achieving command of the sea and neutralizing an enemy fleet. Finally, carrier-dominated maritime operations shifted from being offense-dominated to defense dominated. All this occurred in less than two decades. See Wayne Hughes, *Fleet Tactics* (Annapolis, MD: Naval Institute Press, 1986), pp. 93–110.

[152] Transformation, or even innovation, is often difficult for large organizations. Andrew F. Krepinevich, "Why No Transformation?" *Joint Forces Quarterly* (Autumn/Winter 1999–2000), pp. 97–101. See also Andrew F. Krepinevich, Jr., *The Army and Vietnam* (Baltimore, MD: The Johns Hopkins University Press, 1986); Barry Watts

- *What is the possibility that competitors will pass through some brief intra-transformational regimes that are different in substantial ways both from the current regime and the post-transformation regime?* For example, there may be a brief period following the completion of current US theater missile-defense development programs, but before the full impact of the continuing decline in missile costs and the diffusion of missile technology has been felt. During this period, US missile defenses may achieve—albeit briefly—high levels of effectiveness. Or there may exist a mini-regime that sees the United States field a reconnaissance grid, enabling it to target effectively critical enemy mobile targets before widespread competitor application of effective C4ISR countermeasures (e.g., multispectral decoys, stealth). Or there may arise a brief period in which even small groups or individuals can wreak significant havoc with an advanced society's information infrastructure and, by extension, its national economy, through electronic strikes. The challenges for strategic planners here are formidable. First, they must identify potential mini-regimes along the transformation path. Second, they must avoid mistaking such way-stations on the path to the new regime for the new regime itself. Third, they must be able both to exploit the opportunities that such periods present, while at the same time not locking their military in to a posture that is optimized to deal with the challenges of a distinct, but fleeting, military regime.

Possible Implications of US Treaty Commitments

Current US arms control commitments may exert significant influence on the scope, form and pace of an American transformation to a new strategic-strike regime. For example, the Intermediate-Range Nuclear Forces (INF) Treaty, which was originally negotiated with the Soviet Union in 1987, precludes the United States from developing and fielding ground-launched ballistic and cruise missiles with a range between 500 and 5,500 kilometers.[153] Considering that a variant of the Army Tactical Missile System will soon be fielded with a range of approximately 300 kilometers, the consequences may be substantial.

Similarly, barring a negotiated amendment, the Navy's potential conversion of nuclear-capable ballistic missile submarines to a conventional precision-strike platform may be stymied by START protocols, which require extensive (and expensive) modifications of the submarine's pressure hull.[154] The development of novel precision-strike platforms, such as the stored undersea-strike modules recently recommended by the Defense Science Board, may also run

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and Williamson Murray, "Military Innovation in Peacetime," in Williamson Murray and Alan R. Millett, eds., *Military Innovation in the Interwar Period* (Cambridge, U.K.: Cambridge University Press, 1996), pp. 369–415; and Stephen Peter Rosen, *Winning the Next War* (Ithaca, NY: Cornell University Press, 1991), pp. 8–22.

[153] *Arms Control and Disarmament Agreement–Texts and Histories of Negotiations* (Washington, DC: ACDA, 1990), pp. 345–62.

[154] For an SSBN to SSGN conversion to be compliant with START," either the entire missile section must be removed from the submarine; or all the missile launch tubes, and all elements of their reinforcement, including hull liners and segments of circular structural members between the missile launch tubes, as well as the entire portion of the pressure hull, the entire portion of the outer hull, and the entire portion of the superstructure through which all the missile launch tubes pass and that contain all the missile launch-tube penetrations must be removed from the submarine." "Protocol on Procedures Governing Conversion or Elimination," of the START I treaty, Section IV, paragraph 5 available on-line at: www.state.gov/www/global/arms/starthtm/start/convpro.html#convproIV.

afoul of START provisions.[155] START restrictions might also interfere with the development of future ship-launched missiles such as follow-on naval-variants of the ATACMS and may also preclude placing precision munitions on unmanned aerial vehicles.

To be sure, arms control agreements have, on a number of occasions, served US interests well in the past. However, as noted, some arms control agreements have yielded unintended consequences with respect to the development of US nonnuclear military capabilities.[156] Future arms control negotiations must attempt to account for the rapid advances in military-related technologies so that they do not produce unintended negative effects on the United States' ability to develop the military capabilities required to enhance its security.

SOURCES OF US COMPETITIVE ADVANTAGE

As the discussion above indicates, it is difficult to ascertain with precision the character of a post-transformation strategic regime. Nevertheless, the broad framework of such a regime—the change in the means employed for strategic-strike operations, the increase in the number of states with the ability to conduct strategic strikes, etc.—can be divined with some degree of certainty. Within this framework, the United States appears to possess a number of enduring competitive advantages that should be explored in the process of developing a strategy for achieving its security interests in the emerging strategic-strike regime. One important, enduring US advantage is that of scale: the United States is the world's richest country, as measured in terms of gross domestic product. It also possesses a technically literate population.

To this must be added America's lead in many of the technologies underpinning the emerging military revolution (see Figure 4 below). The United States will likely continue to lead in areas of the competition that may prove important, such as missile defenses, defense against electronic attack and the exploitation of space to enhance the effectiveness of terrestrial-based strategic forces. It is possible, although by no means certain, that the United States could use these advantages to shape the competition (e.g., to discourage would-be competitors by establishing a dominant position in certain capabilities, such as in highly effective IW offensive or defensive capabilities or effective missile defenses).

Yet another principal source of competitive advantage is the US alliance structure. Many of the states having the greatest potential to exploit the emerging strategic-strike regime, such as France, Germany, Great Britain, and Japan, are long-standing allies. By making it more difficult

[155] For more details on these weapon systems concepts see: DSB 1998 Summer Study Task Force, *Joint Operations Superiority in the 21st Century*, Volume II, Chapter 1. See also Ernest Blazar, "Tomorrow's Instant War," p. 8. START explicitly bans ballistic missiles with a range in excess of 600 kilometers from being deployed on "waterborne vehicles, including free-floating launchers, other than submarines" and also prohibits "launchers of ballistic and cruise missiles for emplacement on or for tethering to the ocean floor, the seabed, or the beds of internal water and inland waters. . . ." START Treaty, Article V, Section 18; available on-line at www.state.gov/www/global/arms/starthtm/start.html

[156] This phenomenon is not new. For example, the Washington Naval Treaty of 1922 "froze" the construction of new battleships by the world's major naval powers, while only placing a ceiling on the construction of aircraft carriers. This incentivized several navies, especially those of the United States and Japan, to develop the carrier forces and naval aviation that dominated maritime combat in World War II.

for a hostile competitor to form a counter-coalition, these alliances also reinforce the US advantage of scale.

Figure 4: Key Technologies Underpinning the Emerging Military Revolution

Geography may also be a source of enduring US competitive advantage. To be sure, the death of distance associated with certain forms of electronic warfare, and the proliferation of missile technology, promise to erode much of this advantage over time. However, the United States will still benefit significantly from its relative geographic insularity. For example, states on the Eurasian landmass will almost certainly continue to confront a greater risk of attack from ballistic and cruise missiles employing nuclear warheads and from large-scale strategic attacks involving precision and EMP/HPM weapons, than will the United States.

SOURCES OF US COMPETITIVE DISADVANTAGE

The United States will probably suffer from some enduring competitive disadvantages as well. The United States has led the way to developing an information economy, with all the benefits that confers. Correspondingly, however, having the most advanced information economy may make the United States the most vulnerable to electronic attack. Consequently, the United States may find itself needing to invest more heavily in IW defenses than its less-advanced competitors.

The leader typically pays a premium in its efforts to create or sustain its advantage. Defense establishments pushing new technology to its limits often end up moving down blind alleys to

dead ends in their attempt to develop revolutionary new capabilities.[157] These mistakes can be avoided by those competitors who follow the leader. In short, both of these areas of competitive disadvantage may erode the enduring US scale advantage discussed above.

To the extent that the new strategic-warfare regime offers opportunities for ambiguous aggression, this may represent another source of enduring competitive disadvantage for the United States. Electronic strikes against US government information systems originating from Russia and China during Operation Allied Force in the spring of 1999 offer some insight as to the dilemmas that might confront Washington decision-makers. Although the strikes originated from Russian and Chinese soil, US decision-makers could not confirm that they were undertaken at the direction of the regimes in Moscow and Beijing, respectively. Nor was it clear what kind of electronic attack would constitute an act of war.[158]

Of course, ambiguous aggression is a course of action open to the United States as well as to its competitors. However, as a democracy, the United States is confronted with constitutional and other legal injunctions designed to inhibit aggression, ambiguous and otherwise.[159] From a relative standpoint, it seems unlikely that the United States would adopt a strategy based on ambiguous aggression, or rely upon it more than an authoritarian or totalitarian adversary or nonstate actor (e.g., terrorist group, international crime syndicate).

CHARACTERISTICS OF THE COMPETITION

An assessment of the emerging strategic-warfare balance would likely require an examination of the competitive dynamics that exist when many competitors are involved, as opposed to the two principal competitors that defined the Cold War-era competition. It also would be helpful to identify, if possible, whether the overall strategic-strike regime and its major sub-elements are offensive dominant or defensive dominant, and whether such dominance is likely to be stable or dynamic.

While the nuclear dimension of the strategic-warfare competition seems certain to favor the offense and to remain stable, the same cannot be said with respect to precision and electronic strategic strike. For example, with respect to precision strategic strike, the regime might be defensive dominant and dynamic. For example, one could likely accept a far higher leakage rate in defending a strategic target base against attacks from precision munitions than from nuclear warheads. Active defenses could, over time, reduce the attacker's means of delivering precision weapons, and passive defenses (e.g., deep-underground targets, decoys) could render precision

[157] Examples of such dead-end attempts at innovation include the use of airships for strategic bombardment and the flying-deck cruiser for naval aviation.

[158] Bob Brewin, "Cyberattacks against NATO Traced to China," *Federal Computer Week*, September 1, 1999; "Foreign Hackers Plunder Information from Pentagon Computers," *Los Angeles Times*, October 7, 1999; Michael A. Vatis, director of the National Infrastructure Protection Center, Federal Bureau of Investigation, Statement before the Subcommittee on Emerging Threats and Capabilities, Senate Armed Services Committee, Hearing on the National Infratstructure Protection Center, March 1, 2000.

[159] America's recent history is far more one of being surprised by acts of aggression (e.g., the Japanese attack on Pearl Harbor, the North Korean invasion across the 38th parallel, the Soviet invasion of Czechoslovakia, Saddam Hussein's invasion of Kuwait) than initiating them.

weapons ineffective in ways that nuclear weapons would not be. The competition could also be dynamic. The balance between offense and defense could shift rather quickly, for example, if the defender were subjected to a preemptive attack while his defenses were not on alert.

The electronic strategic-strike regime is shrouded in even greater uncertainty. Will this regime be offensive or defensive dominant? Stable or dynamic? The answers to these questions are far more difficult to come by than for the nuclear- and precision-strike elements of a post-transformation military regime. One suspects that this will remain the case over the foreseeable future. Given the democratic aspect of some elements of strategic-electronic attack, this subregime could be populated by many competitors, complicating efforts to discern the characteristics of a state's (or group's) electronic-strike arsenal. The fact that electronic weapons, both offensive and defensive, can be developed in far greater secrecy than can nuclear or precision weapons further heightens the uncertainty surrounding the competition. Finally, the possible reluctance of key elements of a competitor's target base—such as a state's commercial industrial sector—to share with its government the details of the electronic defenses it has erected to defend itself (or even to report that it has been successfully attacked, and thus, is vulnerable) only adds to the uncertainty under which strategic planning must take place. Any assessment of the strategic-warfare competition should accord high priority to developing a better understanding of the dynamics of this element.

The more holistic view of the competition would also be needed. As with the nuclear triad based nuclear delivery systems, each element of the new triad has unique strengths and weaknesses, suggesting a combined arms or multidimensional regime.[160]

COMPETITOR STRATEGIES

A post-transformation strategic-warfare regime may find US competitors pursuing very different strategies from that of the Soviet Union during the Cold War. If so, the United States will likely find it necessary to consider different strategies for maintaining a favorable military balance in this competition.

One key factor that must be considered is how adversaries will view strategic warfare as a means for achieving their national security objectives. During the Cold War, the United States fielded strategic-warfare capabilities (i.e., strategic nuclear forces) primarily to deter Soviet nuclear strategic strikes in particular and Soviet aggression in general.[161] Each superpower was deterred from contemplating nuclear weapons use out of fear that its adversary's retaliatory blow would wreak catastrophic damage on its own homeland. In short, the superpowers lived in a regime defined by mutually assured destruction. Will rising nuclear powers view strategic warfare in the same way? Perhaps. But the possibility that competitors will pursue different strategies cannot be

[160] The term "combined arms" centers around the use of various force elements or arms (e.g., infantry, artillery, armor) in such a way that their overall (combined) effectiveness exceeds the sum of the effectiveness of the individual components.

[161] To be sure, there was discussion in senior US circles during the Cold War's first decade over the possibility of waging preventive war against the Soviet Union. To some, the US defense posture of massive retaliation also meant massive pre-emption in the event Soviet preparations for a nuclear first strike were detected.

discounted. The range of possible strategic postures is substantial. The following two strategic postures are presented for illustrative purposes.

The Nuclear Shadow

The number of states possessing nuclear weapons, and ballistic and cruise missiles, has grown in recent years. Moreover, the barriers to developing certain forms of electronic strike seem rather low. Proliferation of these military capabilities seems almost certain to continue. If both the nuclear- and electronic-strike elements of the post-transformation strategic-warfare regime are offensive dominant, then the United States will likely confront a significant number of states that have the means to inflict widespread damage on the American homeland, and the ability to project them over great distances. If such a condition obtains, would-be adversaries—especially would-be regional hegemons—may adopt highly effective sanctuary strategies.

The goal of a competitor's sanctuary strategy would be simply to discourage any US attack on its territory by virtue of its ability to inflict significant (or unacceptable) damage on the American homeland. The strategy's principal purpose would be to undermine the US ability to undertake power-projection operations by raising substantially the potential costs incurred by the United States of waging major regional wars, or even conducting punitive strikes. By reducing the danger of a strategic-warfare campaign being waged on the aggressor's homeland, this strategy could lower the prospective costs of regional (i.e., local) aggression. The result could find a growing number of states accorded sanctuary status from US attack. Campaigns such as those conducted by the United States against North Korea, North Vietnam and Iraq over the past 50 years might become much more risky propositions, if and when such future rogue states come to possess their own nuclear weapons.[162]

Ambiguous Aggression

If they prove ubiquitous, effective and difficult to trace and tag, electronic forms of strategic strike could usher in an era of ambiguous warfare.[163] The elements of deterrence that could sustain a limited warfare regime could hardly be expected to hold if an aggressor could not be quickly or reliably identified. An assessment of the emerging strategic-strike regime should, therefore, accord high priority to determining whether the uncertainty surrounding this form of strategic warfare can be reduced to the level where strategic electronic strikes cannot be executed without being promptly detected.

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[162] A competitor's willingness to commit an act of aggression against its neighbor might be reduced substantially if the prospective victim has nuclear capabilities as well. The debate over whether the proliferation of nuclear-strike capabilities would produce a more stable international regime is a long one which has yet to be put to the test. The proliferation of precision/electronic strategic-strike capabilities seems likely to add another layer of complexity to this debate. See, for example, Kenneth Waltz, *The Spread of Nuclear Weapons: More May Be Better*, Adelphi Paper, No. 171 (London: International Institute for Strategic Studies, 1981).

[163] In addition to tracing the electronic strategic strike to its source, it will likely be necessary to tag the source as representing the conscious act of a government or organization. For example, the United States was able to trace the source of electronic attacks during Operation Allied Force to locations in Russia and China. The US government apparently was not able, however, to discern whether the governments of those states sanctioned these attacks.

SCENARIO-BASED PLANNING

One means for coming to grips with the formidable geopolitical and military-technical uncertainties involved in planning for strategic-strike transformation is to develop several scenarios that examine different post-transformation end states and some scenarios that explore different transformation paths to those end states.[164] The variance in the scenarios should be derived from an understanding of the principal driving forces that will shape a post-transformation strategic-strike regime. Determining these geopolitical and military-technical drivers is a crucial part of scenario development, and thus of our ability to understand and prepare for the post-transformation competitive environment. What are the key drivers that will shape the strategic-strike competition? Among the possible candidates are the:

- Substitution effect of nonnuclear strategic-strike weapons for nuclear weapons;
- Emergence of effective air, missile and/or electronic defense capabilities;
- Rise of great power regional competitors (i.e., the problem of scale);
- Diffusion rate of WMD, stealth and long-range precision-attack capabilities;
- Continuation or imposition of arms control regimes that effectively preclude the development or improvement of key military capabilities;
- Ability to strike—with nonnuclear means—critical mobile targets with high confidence of destruction;
- Problem of deterring and responding to ambiguous attacks (e.g., electronic attacks against key economic infrastructure targets or key military C4ISR components);
- Transformation of strategic centers of gravity away from industrial-based economies and toward information-based economies; [165] and the
- Weaponization of space.

Several post-transformation end states might be examined within these scenarios, to include:

- A *multipolar, multidimensional strategic-strike regime* (e.g., five or six major strategic-strike powers with a much more varied mix of strike elements comprising their individual triads), as opposed to yesterday's essentially bipolar nuclear force regime; or today's fading bipolar nuclear regime combined with a US monopoly in strategic precision and electronic strikes;

[164] For a general discussion of scenario-based planning, see Peter Schwartz, *The Art of the Long View* (New York: Doubleday, 1991). See also Andrew F. Krepinevich, Jr., *The Conflict Environment of 2016: A Scenario-Based Approach* (Washington, DC: Center for Strategic and Budgetary Assessments, 1996) for a military perspective on the topic.

[165] For example, advanced economies seem likely to become more information intensive, more globally interdependent and more geographically diffused over time. This may alter substantially the way in which strategic attacks are conducted on a state's economic infrastructure, necessitating major changes in doctrine and forces.

- *A diffused strategic-strike regime* (e.g., widespread availability of extended-range precision munitions, broad diffusion of effective offensive information-warfare capabilities, and difficulty in determining the source of certain forms of precision strike, and of electronic strike in general);

- *A defense dominant regime* in which robust defenses or offsets exist against missile attack, precision attack and/or electronic attack; and

- *A sanctuary regime* in which those states possessing strategic-strike capabilities are accorded sanctuary status from strategic strikes.[166]

Measures of Effectiveness

The quantities and qualities of the equipment and people comprising a military's strategic-strike capability alone will not determine its effectiveness. One must also consider the concept of operations for their employment and how well that concept fares when matched against enemy capabilities and operational concepts. Indeed, the measures employed to determine the effectiveness of future strategic-strike operations seem likely to change from both earlier conventional and nuclear strategic-strike measures. An example of this shift was evident in the work of the US air campaign planners during the Gulf War. The planners focused not so much on destroying targets as an end in itself, but rather as a *means* to an end—they sought to incorporate the functional effects of proposed strikes into their planning to represent more fully the true effectiveness of strategic strikes in degrading critical enemy capabilities for pursuing the war.[167]

The importance of choosing good measures of effectiveness can hardly be overstated.[168] A comprehensive treatment of MOEs is, however, far beyond the scope of this paper. This is regrettable, since the measures once employed to determine the effectiveness of nuclear strategic-strike operations (e.g., percentage of population killed, percentage of industrial facilities destroyed), as well as the capabilities of the forces themselves (e.g., warhead yield, missile throw-weight) will likely be displaced by other measures as new triad capabilities are fielded in significant numbers. For example, given that time will almost certainly become an increasingly scarce commodity in the battle space, the ability not only to neutralize enemy capabilities, but also to do so quickly, may become an increasingly important measure of strategic-strike effectiveness. Another important emerging measure may be the degree of degradation incurred by the enemy's information base (or architecture) as opposed to his industrial base. Yet another emerging measure may be the rate of enemy economic reconstitution following conflict termination, as facilitated by the United States.[169] In summary, measures of effectiveness,

[166] This last end state might be modified to accord sanctuary status only to those states with significant nuclear arsenals (e.g., with a nuclear force comprising a dozen or more nuclear weapons and associated delivery systems).

[167] Keaney and Cohen, *Air Power Survey,* pp. 241–42.

[168] For more on this topic, see James Roche and Barry Watts, "Choosing Analytic Measures."

[169] To elaborate, the greater discrimination in conducting strikes embodied in the new triad may be important in encouraging an enemy to cease his resistance. Put another way, if the enemy center of gravity can be disabled in such a manner as to hold out the prospect of relatively rapid reconstitution following the end of hostilities, the

although difficult to determine, must be chosen carefully, given the enormous weight they will carry in determining the character of strategic strikes and the kinds of capabilities that are pursued to support them.[170]

KEY ASYMMETRIES

Any military competition centered on strategic-strike operations will not be purely symmetrical. Not only will the force levels, force mixes, strategic assets, and overall economic and technical resources of the competitors be different, but other important factors, less amenable to quantifiable measurement, will exert an asymmetric influence on the competition.

For example, *geography* will likely play a key role in a post-transformation strategic-strike regime. To what extent would US strategic-strike forces and operations be influenced by a competitor's relative size, demographic and economic resource concentration, ability to employ sanctuaries (terrestrially or in space), or his proximity to the littoral (and, thus, to US maritime precision-strike forces)? Put another way, would US strategic-strike capabilities and operations be the same if its future competitor was China, India or Iran as opposed to Soviet Russia?

A competitor's *strategic culture* will also influence the competition. The United States, for example, seems to have established a strong cultural bias against preventive war or preemptive attack, irrespective of its potential strategic effectiveness. On the other hand, some states have exhibited a strong tendency to favor preemption, to include Japan during its imperial era and, more recently, Israel. [171]

Other aspects of strategic culture should be considered as well. For instance, the United States has established, over time, a strong tendency to rely upon institutions and legal mechanisms as guarantors of security interests, to include employing arms control as a means of regulating military competition. This may make the United States more vulnerable to having its strategic-strike forces shaped by international agreements, especially arms control agreements.[172]

Similarly, the United States' purported enduring interest in minimizing casualties (to include those of enemy noncombatants) may influence both the targets it strikes, the circumstances under

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positive incentive of such a prompt return to normalcy may help outweigh the incentives to continue military resistance.

[170] It should be noted that, assuming the proper MOEs have been selected, there remains the challenge of actually obtaining the requisite data to support them. For example, if one MOE involves degrading the enemy's economic information infrastructure, then that enemy infrastructure must be identified and its critical nodes mapped. Effects targeting must be considered. Finally, the ability to conduct prompt, accurate battle damage assessments must be developed.

[171] This is not to say that strategic culture is absolute. For example, the United States has conducted preemptive attacks in the past (e.g., Panama in 1989, Grenada in 1983, the Dominican Republic in 1965), but against minor powers within its sphere of influence. And, to be sure, not all Americans are comfortable relying upon international bodies as effective means for providing security—witness the US refusal to become a member of the League of Nations. Rather, what we are speaking of is a strong *propensity* on the part of competitors to behave, or compete, in certain ways.

[172] See, for example, the discussion of possible legal obstacles affecting the rate and scope of the transition to the new triad, on pp. 35-37 of this work.

which those targets are attacked and the weapons employed. Other competitors that have traditionally exhibited much less concern over the loss of human life (e.g., China) may be influenced by this aspect of strategic culture but in a very difficult way. In short, strategic culture can offer insights as to the unique patterns that various competitors have established in earlier competitions that might shed light on how they will compete in the future.

Alliances and *coalitions* are yet another potentially important asymmetry in assessing the future competitive environment for strategic-strike operations. Even during the Cold War, when the bipolar international system made for relatively rigid alliance structures, asymmetries existed. The United States, for example, could count on several allies, such as the United Kingdom and France, to possess substantive levels of nuclear forces, as well as on other allies for the basing and support of its nuclear forces. The Soviet Union enjoyed no corresponding advantage. What types of alliances and coalitions might exist under the emerging strategic-strike regime? Will such structures be characterized by a senior (superpower) member and several very junior members, or will lower levels of nuclear weapons and more diversity in the means for conducting strategic strikes lead to a more multipolar system? Will alliances and coalitions tend to be relatively rigid, as in the Cold War, or transitory in nature? Finally, what would the implications of these key variables be for how we think about the strategic-strike competition?

STRATEGY

Once the issues raised above have been addressed, it then becomes possible to begin developing a strategy to optimize the prospects for achieving US security objectives with respect to strategic-strike operations. Formulating such a strategy is far beyond the scope of this report. Fortunately, however, the Defense Department will have at least two opportunities to address the matter in the coming months, as a consequence of its requirement to undertake a broad review of military strategy, policy, programs, and budgets (the Quadrennial Defense Review), as well as a Nuclear Posture Review.

VI. CONCLUSIONS

Today the United States faces a dramatically different security situation than it confronted during the Cold War. On the positive side of the ledger, the risk of a large-scale, nuclear missile attack on the US homeland has receded dramatically with the collapse of the Soviet Union, the elimination of nuclear forces in the former Soviet Republics and the steady erosion of Russia's remaining nuclear forces. However, assuming current trends continue, a host of new concerns will likely occupy the minds of America's defense strategists over the coming decade, to include:

- The threat presented by a growing number of relatively small nuclear powers;
- The proliferation of advanced chemical and biological weapons to both state and non-state actors as an inevitable, but unwelcome, result of the information and biotechnology revolutions;
- The heightened prospect of ballistic and cruise missile attacks against the US homeland or the territory of friends and allies; and
- The emergence of strategic information warfare as a new means of homeland attack.

Against this backdrop, the US military is currently investing billions of dollars annually in developing and deploying a broad range of new conventional and electronic-strike weapon systems. These weapons, which benefit from a combination of increased range, speed, precision, and overall lethality compared to earlier generations seem likely over time to blur, perhaps substantially, what was once a relatively clear distinction between nuclear and conventional weapons. Today it is possible to envision, in a small but significant number of instances, the US military conducting nonnuclear strategic-strike operations at levels of military effectiveness approaching those of nuclear strikes.

The Minuteman III ICBM, the Ohio-class SSBN, and the B-52 Stratofortress heavy bomber are all reaching the end of their operational service lives and will need to be replaced by a new generation of strategic delivery platforms, starting in about 2020. In light of the anticipated cost of this modernization program and the timelines required to develop and field new delivery platforms, the time has arrived to consider the size and shape of America's strategic forces needed to meet the challenges of tomorrow.

Given these developments, it is all together appropriate that the US Congress has instructed the Secretary of Defense, in consultation with the Secretary of Energy, to conduct a "comprehensive review of the nuclear posture of the United States for the next 5–10 years" and "to develop a long-range plan for the sustainment and modernization of United States strategic nuclear forces to counter emerging threats and to satisfy the evolving requirements of deterrence."[173] This

[173] US House of Representative (106th Congress, 2nd Session), *Enactment of Provisions of H.R. 5408, The Floyd D. Spence National Defense Authorization Act for Fiscal Year–Conference Report to accompany H.R. 4205* (Washington, DC: GPO, October 2000), Section 1041, p. 850.

nuclear posture review, which is to be submitted along with the Quadrennial Defense Review in December 2001, must address the following elements:

- The role of nuclear forces in US military strategy, planning and programming.

- The policy requirements and objectives for the United States to maintain a safe, reliable and credible nuclear deterrence posture.

- The relationship between US nuclear deterrence policy, targeting strategy and arms control objectives.

- The levels and composition of the nuclear delivery systems that will be required for implementing the US national and military strategy, including any plans for replacing or modifying existing systems.

- The nuclear weapons complex that will be required for implementing the US national and military strategy, including any plans to modernize the complex.

- The active and inactive nuclear weapons stockpile that will be required for implementing the US national and military strategy, including any plans for replacing or modifying warheads.[174]

In grappling with these important issues, the Department of Defense should explore fielding a fundamentally new type of strategic triad comprising long-range conventional precision-strike forces, electronic-strike capabilities and a smaller—but modernized—nuclear force. In our view, the United States should seriously consider, unilaterally if need be, scaling back to between 1,500–3,000 highly survivable warheads, carried primarily by SSBNs and bombers. By becoming less reliant on nuclear weapons and taking full advantage of emerging precision- and electronic-strike capabilities, the United States could reap a number of significant strategic benefits over time:

- Potential adversaries would be far more likely to believe, and thus be deterred by, an unambiguous US threat to respond to nonnuclear provocations (e.g., use of chemical or biological weapons) with conventional and/or electronic strategic strikes.

- In the event that deterrence of nuclear use fails, nonnuclear strategic strikes might enable the United States to make nuclear renegades pay dearly for their errant behavior without undercutting the presumption of non-use.

- By adding a rung on the escalation ladder between conventional theater war and nuclear war, the existence of augmented nonnuclear strategic-strike capabilities could not only provide US political leaders with increased flexibility during a crisis, but could also act as a firebreak preventing inadvertent escalation to nuclear war.

[174] US Senate (106th Congress, 2nd Session), *S. 2549—National Defense Authorization Act for Fiscal Year 2001* (Washington, DC: GPO, May 2000), Section 1015, p. 368.

- Maintaining a larger than necessary nuclear force posture incurs a substantial financial opportunity cost in terms of developing and fielding US military capabilities in areas where real shortfalls exist.

- By devaluing nuclear weapons, the United States might encourage other nuclear-armed states to reduce their reliance on these weapons, thereby strengthening the NPT.

However, as also noted in this report, there are potential drawbacks to a new strategic triad that de-emphasizes nuclear weapons and places increased reliance on conventional and electronic-strike capabilities. These possible downsides include the following:

- Precisely because nonnuclear strategic-strike capabilities would be more useable, increased US reliance upon them might spur potential adversaries to acquire at least a small nuclear arsenal for deterrence purposes.

- By calling into question the survivability of the nuclear deterrent arsenal of other states, robust strategic precision-strike and electronic-strike capabilities could conceivably destabilize nuclear deterrence.

- The cost associated with building up a reserve of conventional and electronic-strike weapons large enough to supplant part of the existing nuclear arsenal would likely be substantial.

- Reducing US nuclear weapons levels substantially could so lower the entry barrier to nuclear superpower status that it actually encourages minor nuclear parties to increase their arsenal of such weapons.

- By reducing the perceived risk of nuclear conflict by introducing the option of nonnuclear strategic warfare, it is possible that conventional wars may become more frequent, thereby increasing the risk of inadvertent escalation to nuclear use.

Ostensibly, the development of new means of nonnuclear strategic attack offers military and civilian leaders the best of all worlds—a force that appears to be far more flexible and useable than nuclear forces and also far more effective than earlier forms of nonnuclear strategic attack. The potential benefits of being the first to transform to a new strategic triad could be substantial, including a major increase in military effectiveness (a military revolution to some) over US competitors and a strengthening of strategic deterrence (to include extended deterrence).

In the final analysis, this paper raises more questions than it provides answers. But asking the right questions is the key to laying the foundation for a comprehensive strategic assessment of future strategic-strike operations and the military competition that surrounds them. Any strategic-strike net assessment should recognize the US military's dominant position in the current strategic-strike regime and the commanding lead US forces currently enjoy with respect to the opportunity for completing the transformation to a new strategic-strike regime. However, it also must account for the highly dynamic nature that characterizes military competitions during periods of military revolution. We do not know with high confidence who the major competitors in strategic-strike capabilities will be once this period of transformation ends, perhaps twenty or

so years hence. Nor do we know what paths these competitors will take in terms of developing strategic-strike forces. Yet strategic planners must make decisions today that will determine the effectiveness of United States strategic-strike forces in a post-transformation regime. In its own way, this represents a challenge as demanding for strategists as that posed by the last major transformation in strategic-strike capabilities over a half century ago.

ACRONYMS

ABM	Anti-Ballistic Missile
ACDA	Arms Control and Disarmament Agency
ARRMD	Affordable Rapid Response Missile Demonstrator
ATACMS	Army Tactical Missile System
ATM	Automated Teller Machine
ATR	Automated Target Recognition
AUP-3	Advanced Unitary Penetrator-3
BDA	Bomb Damage Assessment
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CALCM	Conventional Air-Launched Cruise Missile
CAV	Common Aero Vehicle
CBO	Congressional Budget Office
CFE	Conventional Forces in Europe
CINC	Commander IN Chief
CNA	Computer Network Attack
CONUS	CONtinental United States
CTBT	Comprehensive Test Ban Treaty
DSB	Defense Science Board
EMP	Electro-Magnetic Pulse
EPDM	Electronic Power Distribution Munition
ERCM	Extended Range Cruise Missile
FAS	Federation of American Scientists
GBU-28	Guided Bomb Unit-28
GPO	Government Printing Office
HPM	High Power Microwave
IAD	Integrated Air Defenses
ICBM	Inter Continental Ballistic Missile
IO	Information Operations
IW	Information Warfare
JASSM	Joint Air-to-Surface Standoff Missile
JDAM	Joint Direct Attack Munition
JSOW	Joint StandOff Weapon
JTF-CNA	Joint Task Force Computer Network Attack
LCM	Low-Cost Missile
LOCAAS	Low-Cost Autonomous Attack System
MIRV	Multiple Independently-Targeted Reentry Vehicles
MOE	Measure Of Effectiveness
NCA	National Command Authority
NMD	National Missile Defense
NPR	Nuclear Posture Review
NPT	Nuclear Non-Proliferation Treaty
NRDC	National Resources Defense Council
PDD	Presidential Decision Directive
PGM	Precision Guided Missile
R&D	Research and Development
SCADA Systems	Supervisory Control and Data Acquisition Systems
SIOP	Single Integrated Operational Plan

SLAM-ER	Standoff Land Attack Missile-Expanded Response
SLBM	Submarine Launched Ballistic Missile
SMF	Strategic Missile Forces (Russia)
SOV	Space Operation Vehicle
SPACECOM	SPACE COMmand
SRF	Strategic Rocket Forces (Russia)
SSBN	Nuclear-Powered Ballistic Missile Submarine
SSGN	Nuclear-Powered Guided-Missile Submarine
START	Strategic Arms Reduction Treaty
STRATCOM	STRATegic COMmand
SWPS	Strategic War Planning System
TEL	Transporter-Erector-Launcher (Vehicle)
TLAM	Tomahawk Land Attack Missile
TMD	Theater Missile Defense
UAV	Unmanned Aerial Vehicle
UCAV	Unmanned Combat Air Vehicle
WMD	Weapons of Mass Destruction