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U.S. Nuclear Strategy Reform in the 1990s.

A Working Paper

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This paper is part of an ongoing research project that monitors and describes the status and evolution of U.S. nuclear strategy. The paper builds on material published and co-authored by Kristensen between 1997 and 1999, including "Dangerous Directions" (with William Arkin), *Bulletin of the Atomic Scientists*, March/April 1998, "Proliferation of Weapons of Mass Destruction and US Nuclear Strategy," published by the British American Security Information Council in March 1998, and “Targets of Opportunity,” *Bulletin of the Atomic Scientists*, September/October 1997. The project is funded by a research and writing grant from the MacArthur Foundation to study U.S. nuclear war planning and also incorporates material researched with the support from the Ploughshares Fund. Kristensen can be reached at hkristensen@nautilus.org.

Introduction

In October 1999, the Pentagon put in to effect the SIOP-00 (the Single Integrated Operational Plan), the latest in a long line of periodic nuclear war plan updates. This plan also represents the culmination of nearly a decade of redesigning the entire U.S. nuclear war planning system, upgrading existing nuclear forces to post-Cold War challenges, and incorporating new guidance to broaden targeting in China and take on new enemies armed with Weapons of Mass Destruction. SIOP and several Limited Nuclear Options range from a demonstration attack with a single weapon to a half-hour spasm of more than 600 missile strikes, delivering almost 3,000 warheads.

This design does not reflect the world's political changes as they occurred in the 1990s, nor did it come about mainly because the President has revised the concept of deterrence. Instead, it is the product of a major reform of nuclear planning system and vast improvements in computer processing that allow near-instant re-targeting of far more accurate and flexible weapons (which were first introduced in the 1980s). By eliminating unnecessary targets and outdated software and hardware products, war planners have been able to more finely focus on enemy decapitation.

Much of this reform, however, is unknown to the public and the disarmament community that has largely focussed on the implementation of Cold War-type arms control treaties. Yet, as nuclear arms control finds post-Cold War force levels and the disarmament process grind to a halt to preserve enduring stockpiles indefinitely, it is in the nuclear planning reform that the characteristics of nuclear deterrence in the 21st Century are to be found.

The challenge that the world changes presented U.S. nuclear planners with was not merely how to reduce the number of nuclear weapons and update the war plans accordingly. It was the daunting task of converting a massive-scale, bulky, nuclear warfighting machine, directed by relatively uniform guidance for fighting World War III with the Soviet Union, and instead transforming it into to a flexible, trimmed and adaptive deterrence apparatus suitable for use in a wide variety of scenarios and capable of responding to continuous change in guidance and policy. This conversion required a reform of nuclear planning that could endure still deeper reductions in the number of nuclear weapons while *expanding* deterrence and warfighting requirements so that planners could "go global" in pursuit of enemies and targets. From the planner's perspective the world changed from a weapons rich to a target rich environment.

In reviewing this development, this paper takes a two-tract effort: one that looks at the predominant driver in U.S. nuclear planning -- Russia; and another that reviews the increasingly prominent influence from China and the "rogue" states armed with Weapons of Mass Destruction.

The Russian Focus

The latest war plan is the result of a reform process that began in 1989, when Defense Secretary Dick Cheney ordered a review of nuclear targeting. In 1986, SIOP forces had been assigned 16,000 individual Soviet targets,[1] and even at the end of the Cold War the number remained at 12,500. Increased "damage expectancy" and the demands of promptness had resulted in a constant cry for more weapons and improved capabilities. As a result of that review, in January 1991 Cheney directed a reduction in the number of warheads to be included in various attack options, and he called for targets to be reduced by 2,500 to some 10,000.

Even so, Cheney's directive was virtually obsolete by the time it was issued, outpaced by a series of fast-moving events. All the targets in Eastern Europe had evaporated, and in 1991 President George Bush had announced significant unilateral initiatives, to which the Soviets had responded in kind. When SIOP-93 was rushed into effect on June 1, 1992,[2] targets had been reduced by nearly 40 percent. Meanwhile, Gen. Lee Butler, then commander of U.S. Strategic Command (STRATCOM), began his own unilateral review process. Applying "nodal" or network analysis, STRATCOM was reducing targets by the hundreds, shifting the focus of attack to the interlinked capabilities of communications, electrical power, and other networks, rather than to their individual elements. It was a reform specifically intended to reduce the gross number of targets without a change in national guidance.

As 1993 came to a close, war planners focused on how to respond to Russia's arsenal of mobile missiles (road-mobile SS-25s and rail-mobile SS-24s). The difficulty in locating Iraqi Scud missiles during the 43-day Gulf War had convinced the planners that the best solution was to destroy mobile targets *before* they had an opportunity to disperse. And it demanded survivable weapons able to be rapidly retargeted as intelligence identified new locations. A lengthened World War III was born which will continue to influence and drive nuclear planning in the years to come as more mobile missile systems become available around the world.

It was virtually an incantation at this point that no more reductions could be made and still meet the requirements of "the guidance." Nor did the Clinton administration seem particularly interested in revising U.S. deterrence policy, which demanded a grandiose guaranteed destruction of Russia's nuclear forces, command and control, industry, and conventional forces. But many, such as General Butler, still thought that the war plan could be made more rational through planning reform. In November 1992 Butler had directed the formation of an internal STRATCOM Strategic Planning Study Group. Its goal was to reduce the time needed to develop new war plans and to make planning "responsive and flexible to meet current and future planning needs." According to the STRATCOM history, the group would focus on the post-Cold War need "to adapt the war

planning process to rapid modifications in guidance."

Outside STRATCOM, few people had a clear understanding of what strategic nuclear war planning was all about. Creating the various war plans with their choreography of nuclear war-fighting was so complex that few outside STRATCOM's Omaha headquarters were in a position to challenge its claims about "required" readiness, synergy, or military capacity. And by staying firmly in control of all the analytical tools, STRATCOM could deflect any of Washington's proposed changes.

Despite efforts within the office of the Secretary of Defense to better understand the SIOP, STRATCOM charged ahead with its modernization. It mapped and charted and consolidated functions and designed new systems to comprehensively modernize a process that had become inefficient over the years. At the core of this effort was a complete modernization of the Strategic War Planning System (SWPS), a name for the compilation of facilities and capabilities that are used to analyze targets, assign warheads to targets and deliver the weapons. The main innovation of the modernization was the recommendation that a "living SIOP," a less rigid and more adaptable system, be created.

Until recently, updating the SIOP was a major task, taking 14-18 months to complete. Even SIOP- 94, completed in Spring 1993 after significant reductions in target numbers following the break-up of the Soviet Union and the demise of the Warsaw Pact, took nearly 17 months.[3] The “living SIOP,” by contrast, is based on continuous analysis of guidance, forces and target changes, rather than a fixed plan, reducing the time for complete overhaul of the SIOP to six months.[4] Wholesale revision of an attack plan for a new enemy will now be possible in months. According to the group's final declassified report, the new plan "would be maintained on a daily basis in response to changes to targets, forces, and . . . guidance." Until the need for an entirely new plan was identified, the existing plan would be re-optimized continuously, with no prescribed revision date. If a new national guidance had to be issued, a totally new SIOP could be "rolled forward . . . eliminating the need for and time involved in replanning."[5]

As General Butler explained in 1993, the basis for the living SIOP was "adaptive planning," a flexible process that used "generic targets, rather than identifying specific scenarios and specific enemies, and then crafting a variety of response options to address these threats." To maintain the war-fighting choreography called for under various levels of alert, another innovation -- called the "stable nucleus" -- was introduced. This was defined as "a core set of targets and special attacks that do not change substantially over time, thereby eliminating the need, and the time involved, in making major changes." The stable nucleus was, of course, the same old "counterforce" targets -- Russia's strategic nuclear forces and leadership. Reductions could now be accommodated as long as the stable nucleus was not threatened.

General Butler approved the living SIOP concept in July 1993. Over the next

year, STRATCOM worked to develop the new system, and by December 1994, the process was sufficiently in place to propose an actual model war plan to replace SIOP-95.[6] Who could argue with greater flexibility and adaptability?

This happened at the same time that the Nuclear Posture Review (NPR) began. Proclaimed as the most comprehensive review of U.S. nuclear policy in decades, STRATCOM anticipated and headed off any idea of true reductions and thwarted any attempts by the NPR to eliminate the triad of forces. The NPR process was headed by Assistant Secretary Ashton Carter and at STRATCOM there were concerns about the "negative feelings" Carter had demonstrated in the past toward nuclear weapons. STRATCOM's background check on Carter indicated "a less-than favorable long-term outlook for nuclear weapons" and long-term visions of "complete denuclearization." These were not popular views to a command whose very existence relied on nuclear weapons. Persuading such policy makers of a continued need and "wider role" for nuclear weapons would be, STRATCOM feared, "an uphill battle."[7]

STRATCOM had already decided what the broad lines of the NPR outcome should be and used its considerable resources to influence it. Two years earlier, after the June 1992 Washington Summit Agreement, STRATCOM produced a study of future force postures that analyzed the numbers and combinations of forces required for START II implementation and beyond and compared them with the ability to fulfill military and White House guidance. The top-secret "Sun City" study focused on the amount of capability and war-fighting flexibility that would be lost at different levels. It looked at nine different force structure options, six at the START II limit of 3,500 accountable warheads, and three "well below" 3,500 weapons (essentially various START III models).[8]

The study's core assumption was that an unchanging counterforce capacity was required. A "penalty for capability lost" was assigned to various lower force structures, and those options were then deemed unacceptable. The force with the highest capability and flexibility became the only choice. It is not surprising that STRATCOM's "preferred" force structure, the one that had already been approved for the "Living SIOP," was eventually recommended by the Nuclear Posture Review.

Getting More With Less

It was not just with regard to force structures that the war planners got their way. STRATCOM also lobbied successfully for programs that would continue to heighten the capability of U.S. nuclear forces. For instance, when funds for the Minuteman III propulsion replacement were cut from the 1994 budget, STRATCOM claimed that the cut would jeopardize "continued Minuteman reliability." But the issue actually concerned the "age-out" of a small portion of Minuteman IIIs during a six-year period after the year 2003. By accelerating propulsion replacement, the entire missile force, not merely 70-80 percent, could stay on alert. When completed in 2008, the year after START II is scheduled to take effect, the

Minuteman III force's life will have been extended through 2020.

War planners also maneuvered a $2.7 billion "Phase 2" guidance improvement effort to increase Minuteman missile flexibility and attain "Peacekeeper accuracy" for the older missile. Phase 2 anticipated calls for de-targeting by introducing "dormant" and "semi-dormant" operational modes, making it possible to electronically stand down the Minuteman III force yet retain the ability to go instantly to alert and launch.[9] STRATCOM also led efforts to fund MX upkeep to insure 100 percent readiness right up to the missile's mandated START II retirement date, and it opposed ending production of the Trident II missile for the strategic nuclear submarines.

Bogged down in bureaucratic and personal quagmires, the Nuclear Posture Review failed to redefine the role of nuclear weapons after the Cold War. In the end, according to an internal STRATCOM report, the NPR "reaffirmed the benefits of ambiguity in existing nuclear weapon declaratory policy." In other words, any presidential de-targeting initiatives or other confidence-building measures could be accommodated, because U.S. policy could say one thing and do another, and new systems increasingly allowed nearly instant shifts back to the core targeting that Washington had agreed was beyond change.

The NPR also blessed another of the "Cold Warrior's" schemes -- keeping the "hedge," an extra supply of non-deployed warheads that provided a non-survivable upload capability. U.S. nuclear forces were not only improved over pre-1990 capabilities, but the United States would retain the capability to fight a protracted nuclear war, at least on paper. President Clinton's approval of the NPR in September 1994 confirmed the war planners' views. They had avoided any significant post-Cold War change and even prevailed in the most recent Pentagon force structure review from 1997 -- the Quadrennial Defense Review -- which concluded that "nuclear weapons remain important as a hedge against NBC proliferation and the uncertain futures of existing nuclear powers." Therefore, the review concluded, the United States will "continue to need a reliable and flexible nuclear deterrent - survivable against the most aggressive attack, under highly confident, constitutional command and control."[10] The Cold War-like assumptions and conclusions of the Nuclear Posture Review remain the basis for U.S. nuclear strategy today as we enter the twenty-first century.

U.S. and Russian Strategic Forces, Today and Tomorrow

What does this development mean for deterrence and the composition of the nuclear arsenals in the U.S.-Russian relationship? For the past three decades, nuclear planners have taken comfort in the notion of mutually assured destruction. That is, both the United States and the Soviet Union (now Russia) have the ability to destroy the other with nuclear weapons, no matter who struck first. Despite certain right-wing delusions in the 1970s and 1980s, neither the Soviet Union nor the United States ever had the ability to strike first *and survive*. Retaliation would be

massive. Given that, nuclear stability reigned, even in times of high tension.

But since the demise of the Soviet Union, the United States has acquired more of a theoretical first strike capability. That is a function of numbers of weapons, their accuracy, and reliability -- and most important, the number of targets ("targets" principally mean weapons of intercontinental range.) If present trends continue, the number of first-strike targets in Russia will so diminish under START II that the United States could launch a preemptive first strike with high confidence. It may be hard to imagine any scenario in which the United States would chose to launch a first strike, but it is just as ridiculous to sit with such a posture in place. Not only is it a recipe for disaster, but the unchanging force undermines any incentive for Russia to ratify START II. Some of the estimates that can be drawn from the current trend are:

Inter-Continental Ballistic Missiles

U.S. intercontinental ballistic missiles (ICBMs) have been reduced from 1,000, armed with 2,550 warheads, to 550 missiles with 2,050 warheads, a reduction of just 19 percent. When the 50 MX missiles are retired under START II, the ICBM force will shrink to 500 Minuteman III missiles upgraded with MX warheads and reentry vehicles. This will provide "Peacekeeper accuracy" for these older missiles through at least the second decade of the twenty-first century.

On the Russian side, ICBMs have declined from 925 missiles armed with 5,575 warheads to 755 missiles with 3,590 warheads, a warhead reduction of 36 percent. After eliminating SS-18 and SS-24 heavy ICBMs (64 percent of the existing force), and retiring all but 170 SS-19s, Russia will have no more than 500-600 missiles, of which more than half will be mobile SS-25s. As a result, the number of Russian ICBM hard-targets will decline from 1,400 at the end of the Cold War to about 270.

Ballistic Missile Submarines

At sea, the nuclear forces have been affected less than any other category of strategic weapons. The U.S. ballistic missile submarine (SSBN) force has been reduced from 32 submarines armed with 584 missiles and 5,024 warheads to 18 submarines carrying 432 missiles with 3,456 warheads. In 1990, 23 of those subs -- or more than 70 percent -- dated from the 1960s. In contrast, today's fleet consists entirely of modern Ohio-class submarines. Even before START II, the number of SSBNs may drop to 14, and medium-term Navy plans foresee a force of 10 submarines. The Trident I missile, upgraded to provide a "moderate" hard-target kill capability, is being replaced entirely by Trident II D5 missiles, which are capable of destroying the "full spectrum" of targets. Navy plans envision funding of a follow-on to Trident II, designated D-5A, somewhere around 2005. Trident IIs will be armed with 384 W88 high-yield warheads, but even with the older W76 warhead, they are still highly capable. The portion of hard-target warheads will increase three-fold from eight percent in 1990 to 26 percent under START II. This year, the United States resumed production of a limited

number of the high-yield W88 warhead at the Los Alamos National Laboratory.

The Russian SSBN force, never an equal leg of the Soviet triad, is currently estimated at 26 submarines armed with 440 missiles and 2,272 warheads. The number of missiles has been reduced by half, but the number of warheads has decreased only 16 percent. However, Russian submarines are at an all-time low in terms of readiness, spending most of their time in port. Russia will likely maintain 15 modern boats in the coming decade, eventually replacing the last Delta IIIs, built in the mid- to late-1970s, with the new Borey-class. Yet the force will probably shrink to less than 10 boats in 2008.

Strategic Bombers

The U.S. operational bomber force consists of 92 aircraft armed with 1,800 modern warheads and cruise missiles. The old fleet of B-52H bombers is expected to fly for another 30 years, the modern B-2 production has stopped at 21 aircraft although the production-line is kept open just in case. The B-1 bomber was removed from nuclear planning in 1997 with SIOP-98, but can be re-nuclearized on relatively short notice if necessary.

In comparison, despite recent show-off deployments of bombers off Iceland, none of Russia's 113 bombers, wherever located, is believed to be in a state of day-to-day readiness. When not on alert, the Russian bomber and strategic submarine force probably present less than a dozen targets. There is no known bomber modernization program.

Altogether, at current alert levels, the United States maintains a robust short-warning first-strike capability. When current reductions and upgrades are completed under START II (in the 2007 timeframe), the United States will retain 900 warheads with hard-target kill capability. In comparison, the Russian force in its START II day-to-day configuration will likely represent some 300 targets. Even adding supporting command and storage, there will be fewer than 500 targets for U.S. nuclear planners to aim their 3,500 accountable START II warheads at. Such a level of overkill capability -- potentially seven highly accurate warheads per target (if ignoring China) -- is of Cold War proportions and difficult to justify even for the most hardened cold warrior. Other reasons for the overkill in the U.S. enduring arsenal must be found outside Russia, primarily in China but increasingly also in “rogue” states.

The Role of China

One of the most significant developments in recent years has been China’s growing role in U.S. strategic nuclear posturing. This development follows half a decade of U.S.-Chinese bickering over Taiwan, proliferation, nuclear spying and human rights issues. Most important in this context, however, has been China’s modernization of long-range nuclear missiles. As the estimated range increased, albeit of a comparatively very limited number of missiles, U.S. nuclear planners began arguing that China should again be the subject of routine nuclear targeting under the SIOP.

China was removed from the SIOP in 1982 and a new separate war plan was prepared for nuclear war with that country. Initially, B-52 bombers were also exclusively earmarked for that plan, but because bombers were removed from alert in 1991, SSBNs took on a more central role vis-àvis China. One rationale for this choice, according to one source, was that the use of U.S. ICBMs to target China would necessitate flight-paths "over the pole" in the direction of Russia in order to hit Chinese targets. In order to avoid Russia thinking it was under attack if U.S. ICBMs were launched against China over Russian territory, SSBNs were seen as a better choice to engage China independently.[11]

During the Nuclear Posture Review in 1994, certain Pentagon officials and planners argued that it was necessary to increase nuclear deterrence of China. They were unsuccessful in getting China back into the SIOP, but China nonetheless featured prominently in the Sun City Extended force structure study STRATCOM prepared in support of its NPR position. A total of 13 pages in the study were dedicated to various "China Scenarios," and one page specifically identified two US/China adversarial scenarios. The first involved a limited attack on China in connection with a conflict involving North Korea. The second involved a direct "China/Continental United States confrontation" and identified that a major-attack response plan had to be written up:

1st Scenario: A US/North Korea/China Excursion.

- ♦ Regional as opposed to global concern
- ♦ Calls for an adaptively planned response against North Korea
  - not a full scale attack against China
- ♦ DPF, non-strategic forces, or conventional (CALCM/TALM-C) response more appropriate solution.

2nd Scenario: Scenario focuses on a China/CONUS Confrontation.

- ♦ Implies a need for a major-attack response plan.[12]

STRATCOM's preference was clear enough and although it didn't get the go-ahead to draw up a major attack option against China in 1994 the planners at Offutt Air Force Base in Nebraska continued to fine-tune the various China scenarios. Intelligence reports about Chinese missile modernizations soon turned the tide in support of STRATCOM's recommendation, so when President Clinton signed PDD-60 in November 1997, it was almost inevitable that the new guidance directed the planners to broaden the scope of targeting in China. Although the details remain unclear, the language was vague enough to allow STRATCOM to formally bring China back into the SIOP with the completion of SIOP-99 in October 1998. As a result, the SIOP now includes a small number of Limited Attack Options devoted to China, involving small numbers of strategic weapons.[13]

The "New" Enemies

The third category of drivers in U.S. nuclear strategy involved the so-called "rogue" states, that is smaller nations generally in opposition to U.S. policy and attempting to acquired weapons of mass destruction (WMD). During the 1990s, planners at STRATCOM and the policy makers at the National Security Council and the Office of Secretary of Defense have been busy incorporating language relating to these countries into U.S. doctrine and strategy as a new justification for nuclear deterrence. These efforts have included not only drawing up specific deterrence and targeting scenarios against countries like North Korea, but also ensuring that such scenarios are prominently reflected in White House guidance.

Planning nuclear war against "rogue" states should not be understood as a formal part of the SIOP, which as a rule of thumb until recently included only Russia. Instead, attack options against these smaller nations involve what is called the Strategic Reserve Force, a pool of some 1,000 warheads on bombers and submarines intended to ensure that no other nuclear power can coerce the United States following a major exchange with Russia. Targets in "rogue" states may involve hundreds of targets and, according to one source, might approach a thousand.[14] To complicate things even further, STRATCOM planning not only involves nuclear but increasingly also non-nuclear weapons, that are finding their way into regional planning -- and even into SIOP planning -- creating a dangerous blur between nuclear and conventional warfare.

The concept of targeting proliferators with nuclear weapons is relatively new to U.S. nuclear doctrine. Proliferation as such was not a prominent driver for U.S. nuclear planning prior to the 1990s, although the United States did target some non-Soviet countries as a matter of course in the late 1980s. This was done, however, as part of a global plan against the Soviet Union and its potential allies to insure against a third country trying to take advantage of the depletion of U.S. arsenals during a major nuclear war. Now, however, proliferating countries are being independently targeted as proliferators of WMD.

Soon after STRATCOM was created in 1992, General Butler explained that the United States already in 1989 "abandoned global war with the Soviet Union as the principle planning and programming paradigm for the U.S. armed forces." The result was a "complete revisit of nuclear weapons policy and the SIOP target base" which not only resulted in the widely reported reduction of targets in the SIOP, but also expanded the geographical scope of targeting. The former "evil empire" was still the focus, but nuclear war planners saw that "a new series of threats had begun to emerge on the horizon," and began to devote more and more attention to potential targets outside Russia and China. The post-Cold War target base would consist of "fewer but more widespread targets."[15]

Very little was said in public about this expansion of nuclear planning, but a

couple of hints were given. In March 1991, the JCS suggested in the Joint Military Net Assessment that non-strategic nuclear weapons "could assume a broader role globally in response to the proliferation of nuclear capability among Third World nations." The report reiterated, however, that nuclear proliferation in general necessitated an upgrade of the command, control, and communication capabilities of U.S. forces, and identified the MILSTAR satellite communications system, designed to provide secure global command and control capabilities for nuclear war fighting, as an example of such an upgrade.[16] Likewise, in February 1992, Secretary Cheney stated in the Defense Department's annual report, "the possibility that Third World nations may acquire nuclear capabilities has led the Department to make adjustments to nuclear and strategic defense forces and to the policies that guide them." U.S. nuclear strategy, Cheney said, "must now also encompass potential instabilities that could arise when states or leaders perceive they have little to lose from employing weapons of mass destruction."[17]

When General Butler testified before Congress in April 1992, he explained the role of nuclear weapons in missions against "rogue" nations. "A U.S. nuclear deterrent force encourages non-proliferation, albeit within limits bounded by rational calculations," Butler said, and added, "Some contend that deterrence is not applicable outside the classic Cold War paradigm – especially when such weapons are in the hands of seemingly irrational leaders. In my view, the very fact that such leaders pursue nuclear capability implies a certain lethal rationality."[18] Later the same month, Assistant Secretary of the Air Force John J. Welch told Congress that "the emphasis of the deterrence equation has been shifted from just deterring the development or use of nuclear weapons by the Soviet Union, to deterring the development or use of nuclear weapons by other countries, as well."[19]

This was the situation even before the Nuclear Posture Review had begun. In January 1993, General Butler told *The New York Times* that "our focus now is not just the former Soviet Union but any potentially hostile country that has or is seeking weapons of mass destruction."[20] Butler set up a new Joint Intelligence Center "to assess from STRATCOM's operational perspective the growing threat represented by the global proliferation of weapons of mass destruction."[21] Three months later, in April 1993, the Joint Chiefs of Staff published the first version of the Joint Nuclear Doctrine (3-12) which formerly incorporated WMD into U.S. nuclear doctrine.[22]

The Role of "Adaptive Planning"

As is the case with nuclear planning against Russia, the revolutionary concept of the "living SIOP" also profoundly impacted the capability to engage WMD proliferators on a global scale. The planners soon realized that Cold War nuclear forces were ill-suited for nuclear war against "rogue" states because the old Cold War focus on the Soviet Union and China meant that hardware and software had "typically been configured for the Northern

Hemisphere only." Key target data processing technologies "currently have no capability south of the equator," STRATCOM concluded in March 1992, and recommended development of a "global capability" by the late 1990s.[23]

Furthermore, with more potential enemies on the radar screen the expansion of nuclear deterrence to smaller and more diverse regional WMD contingencies meant that that guidance were likely to change more frequently than when Russia and China were the main focus. The old war planning system was built to handle updates over a matter of years, but nuclear deterrence in the post-Cold War era would demand changes on a monthly – sometimes even daily – basis. General Butler described the scope of the modernized war planning system in an interview with *Jane's Defense Weekly* in the spring of 1993:

Adaptive planning challenges the headquarters to formulate plans very quickly in response to spontaneous threats which are more likely to emerge in a new international environment unconstrained by the Super Power stand-off.… We can accomplish this task by using generic targets, rather than identifying specific scenarios and specific enemies, and then crafting a variety of response options to address these threats. To ensure their completeness, these options consider the employment of both nuclear and conventional weapons. Thus, by its very nature, adaptive planning offers unique solutions, tailored to generic regional dangers involving weapons of mass destruction.[24]

Planning requirements examined for adaptive planning went well beyond the core SIOP to include items like crisis planning and non-strategic nuclear forces. The modernized war planning system achieved initial operations capability in late 1998, coinciding with the completion of SIOP-99. Full operational capability is expected in 2003, which will vastly expand the U.S. capability to incorporate the routine processing of WMD targets outside Russia.[25]

Moreover, in order to encompass all types of nuclear planning, the modernized SWPS erases the traditional distinction between strategic and tactical nuclear planning. Already in 1992, SAC Commander General Butler emphasized that he wanted to see "a simplified process that makes no distinction between strategic and tactical mission planning," and one of the requirements in the new SWPS is that the process "be able to plan for nonstrategic nuclear force employment."[26] The modernized SWPS achieves a preliminary theater support of non-strategic nuclear weapons planning by January 1998 and the goal is optimized adaptive planning within all the theaters.[27]

So the race is on for rapid retargeting capabilities to allow planning for limited nuclear operations like those in regional contingencies against "rogue" nations in a much shorter time. Work underway at the Air Force's Rome Laboratory a few years ago aimed at providing planners with the capability to plan "critical nuclear options" in the SIOP "within days rather than months" and limited SIOP re-planning options "in less than 30

minutes."[28] Capabilities envisioned in what was previously called the Survivable Adaptive Planning Experiment (SAPE), for example, aimed at allowing SIOP generation in less than 24 hours and re-targeting of up to 1000 relocatable targets per day.[29] While the numbers and names for such projects continue to change, the trend is that nuclear planning must be able to provide for a greater number of smaller, more flexible, adaptive attack options on a relatively short notice.

The Nuclear Posture Review

The Nuclear Posture Review from 1994, which reaffirmed the role of nuclear weapons and approved STRATCOM's preferred force structure as described above, also endorsed the expansion of nuclear deterrence beyond Russia and China to "rogue" nations. Of the six working groups that were created to review U.S. nuclear policy and force structure, one was specifically tasked to look at the relationship between alternative U.S. nuclear postures and counterproliferation policy. The group condoned, although initially somewhat halfheartedly, STRATCOM's inclusion of regional WMD contingencies into nuclear war planning.

During the working group meetings, Ashton Carter's special assistant and former professor at the University of Maryland, Dr. Steven Fetter, argued repeatedly that nuclear weapons could only deter nuclear use or acquisition, although the effect on acquisition was "hotly" debated. No meaningful contribution, Fetter argued, was likely to come from nuclear weapons in deterring chemical and biological weapons of mass destruction.[30] Eventually, both Fetter and Carter were outmaneuvered by STRATCOM and the regional commanders. Even a suggestion by the Office of the Secretary of Defense that chemical weapons should be viewed as a more important threat than biological weapons was strongly opposed by the military representatives.[31] It was all or nothing if deterrence was to be seen as credible.

The documents from the group's meetings provide interesting insight into STRATCOM's thinking on the role of nuclear weapons against proliferating nations. In response to questions asked by the working group STRATCOM explained that while nuclear weapons may not directly affect Third World countries' *acquisition* of WMD, maintaining nuclear weapons could support U.S. political aims. This would be accomplished, STRATCOM said, "through demonstrating intent by maintaining an arsenal and continuously providing war plans to support regional CINCs [Commanders-in-Chief]... Within the context of a regional single or few warhead detonation, classical deterrence already allows for adaptively planned missions to counter any use of WMD," STRATCOM elaborated.[32] Asked about the U.S. response to WMD use, STRATCOM answered:

The U.S. should preserve its options for responding to the situation by maintaining its current policy which does not preclude first use of nuclear weapons. While it would not be in our interest to unleash the destructive power of a nuclear weapon, the loss of even one American city, or the endangerment of vital American interests overseas is

unacceptable. To counter this threat, the U.S. should not rule out the preemptive first use of nuclear weapons. In addition, following the use of WMD, the U.S. should again seek to preserve its options. The U.S. policy should not require retaliation with nuclear weapons, but it should leave that option open as one of a complete spectrum of possible options.[33]

Unlike the military officials, Carter correctly suspected that a stated nuclear deterrence role in WMD scenarios could have negative impact on the NPT regime, regardless of whether the U.S. was legally bound by its Negative Security Assurances. He therefore instructed the drafting groups to suggest possible political, economical and conventional deterrence options that could complement the U.S. nuclear posture.[34] This was to no avail, however, and in the end the counterproliferation working group largely sided with STRATCOM. Not only did it accept STRATCOM's broad nuclear deterrence vision, but it warned that deep reductions in U.S. nuclear weapons might influence proliferators negatively to decide to match U.S. numbers or allies under U.S. protection -- such as Japan and Germany -- to go nuclear.[35] Indeed, within the counterproliferation group there was "group consensus that [the] full range of nuclear options is desirable to deter proliferant nations," and the majority wanted the "unique contribution of nuclear deterrence to counter-proliferation" to be "stated more forcefully."[36]

In addition to the declaratory policy, the group also agreed that nuclear weapons remain the *only* method of destroying certain types of targets including deeply buried facilities.[37] Only on one issue, the question of deterring terrorist use of WMD, did the group see a limitation in the role of nuclear weapons: nuclear deterrence should only apply to state-sponsored terrorism, because non-state actors would not be deterred by the U.S. nuclear posture.[38] Despite this fundamental conclusion, the Joint Chiefs of Staff nonetheless included non-state actors as potential targets for U.S. nuclear weapons in their Joint Theater Nuclear Doctrine publication from early 1996.[39]

This expansion in nuclear targeting was probably aided by the U.S. decision to eliminate its chemical and biological weapons. In the logic of deterrence, removing those types of weapons from the arsenal meant that the United States could no longer rely on a tit-for-tat response to attacks by chemical and biological weapons to deter "rogue" nations from using such weapons. Other than the overwhelming conventional capability, the only "big stick" left in the U.S. arsenal was the threat from nuclear weapons. One of the studies produced for STRATCOM during the NPR warned that the dynamics of deterring regional WMD threats were far from clear. Yet the paper nonetheless embraced that very role:

Nor should we be quick to embrace the position that nuclear weapons should exist only to deal with other nuclear weapons. Those who argue that biological and chemical threats can always be safely deterred without requiring the last resort of U.S. nuclear

forces must bear the burden of proof for their argument. Until they make a compelling case that nuclear force is not necessary for successful deterrence, it is not in the nation's interest to forswear the uncertainty as to how we would respond to clear and dangerous threats of other weapons of mass destruction. 'Measured ambiguity' is still a powerful tool for the President trying to deter an intransigent despot.[40]

Then Commander-in-Chief of STRATCOM, Admiral Chiles, later commended the study group for the document which he said was "particularly effective" in preparing the NPR.[41] In sum, STRATCOM probably could not have hoped for stronger backing from the NPR. When the results were briefed to Congress in September 1994, nuclear weapons featured prominently in counter-proliferation roles such as to "deter WMD acquisition or use." But these conclusions were largely absent from the spin the Clinton Administration gave on the NPR in public, which instead portrayed the NPR as a continuation of the disarmament process and a further "reduction" of the role of nuclear weapons in U.S. national security policy.

Implementing the New Deterrence

After NPR was completed, STRATCOM continued to refine the role of WMD in the U.S. nuclear posture. In April 1995, one of the primary advisory groups to the head of STRATCOM completed an in-depth review of deterrence against Third World proliferators. The review provided "Terms of Reference" to be used as a baseline "to expand the concept of Deterrence of the Use of WMD."

The review, "Essentials of Post-Cold War Deterrence," bluntly criticized the pledge given by President Clinton not to use nuclear weapons against non-nuclear weapon states parties to the NPT. It is "easy to see the difficulty we have caused ourselves," the review said, "by putting forward declaratory policies such as the 'Negative Security Assurances' which were put forward to encourage nations to sign up for the Non-proliferation Treaty." The review warned that, "if we put no effort into deterring these [WMD] threats, they will be 'undeterrable' by definition." Threatening what an adversary values most is essential, the review stressed, and here is the anecdote it used to demonstrate it:

The story of the tactic applied by the Soviets during the earliest days of the Lebanon chaos is a case in point. When three of its citizens and their driver were kidnapped and killed, two days later the Soviets had delivered to the leader of the revolutionary activity a package containing a single testicle – that of his eldest son – with a message that said in no uncertain terms, "never bother our people again." It was successful throughout the period of the conflicts there. Such an insightful tailoring of what is valued within a culture, and its weaving into a deterrence message, along with a projection of the capability that be mustered, is the type of creative thinking that must go into deciding what to hold at risk in framing deterrent targeting for multilateral situations in the future.

The review strongly recommended ambiguity in U.S. nuclear deterrence and used President Bush's warning to Saddam Hussein in January 1991 against using chemical weapons as an example of the value of this. But it added another twist to the equation, warning that in threatening nuclear destruction the United States must not appear too rational and cool-headed. Indeed, that "some elements may appear potentially 'out of control' can be beneficial" to creating and reinforcing fears and doubts within the minds of an adversary's decision-makers. This essential sense of fear, the review concluded, is the working force of deterrence. "That the U.S. may become irrational and vindictive if its vital interests are attacked should be part of the national persona we project to all adversaries."

Although STRATCOM later downplayed the status of this review when it was first disclosed in the press in 1998, it used the deterrence review in a test on a potential WMD adversary. In the fall of 1995, shortly after the crisis over North Korea's threat to withdraw from the NPT, Chief of STRATCOM Admiral Chiles directed that the deterrence review be tested on North Korea. Although the details of that experiment remain classified, it demonstrates that "rogue" states were brought into the mainstream of U.S. nuclear strategy. When President Clinton put his signature on the PDD-60 in November 1997, he not only ordered the nuclear planners to reduce targeting in Russia and broaden the scope of targeting in China, he also identified specific regional contingencies (such as the Persian Gulf and the Korean Peninsula) where U.S. nuclear forces could be directed against opponents armed with WMD.

This was the situation when Germany and Canada in late 1998 proposed that NATO (and thus the United States) should be reviewed and adopt a no-first-use policy. The United States completely rejected a review but instead of referring to the need to deter the enemies that had the most nuclear weapons pointed against the United States, it was "rogue" states armed with chemical and biological weapons that were used as the justification for maintaining status quo. In his dismissal, U.S. Defense Secretary William Cohen stated in what almost looked like a excerpt from one of STRATCOM's submissions to the Nuclear Posture Review working group in 1994:

We think that the ambiguity involved in the issue of the use of nuclear weapons contributes to our own security, keeping any potential adversary who might use either chemical or biologicals [sic] unsure of what our response would be. So we think it's a sound doctrine. It was adopted certainly during the Cold War, but modified even following and reaffirmed following at the end of the Cold War. It is an integral part of our strategic concept and we think it should remain exactly as it is.

Deterrence or Warfighting

The situation of Russia's dwindling nuclear might on the one hand and the increasing prominence of "other" enemies in U.S. nuclear strategy on the other hand, has created several paradoxes:

♦ First: despite the thaw is U.S.-Russian relations, significant reductions in the nuclear arsenals, and the publication of several new directives and reviews changing U.S. nuclear planning in the post-Cold War era, nuclear advocates and unreformed Cold Warriors managed to manipulate nuclear policy, codifying a more flexible and adaptable nuclear war plan, one that now accentuates some of the most threatening and destabilizing aspects of nuclear forces.

♦ Second: while the end of the Cold War has permitted a dramatic reduction in the number of targets in Russia and thus U.S. nuclear weapons, the shift from a weapons rich to a target rich environment with "fewer but more widespread targets"[42] has created inherent obstacles to deep nuclear reductions. As the number of weapons in the U.S. arsenal has declined, the value and role of each weapon has increased. This creates a need for "effective deterrence" which in turn drives force modernization, stockpile stewardship, robust planning capability, threat-warning and survivable forces.

♦ Third: while Russia remains the predominant focus of U.S. nuclear planning and the target for the vast majority of U.S. nuclear warheads, it is China and "rogue" states that are mainly pointed to when the U.S. nuclear posture is defended.

♦ Fourth: although defense planners point to the need to maintain ambiguity about the likely U.S. response to a chemical or biological weapons attack, such a policy may be not only inconsistent but inherently dangerous because the United States cannot make its nuclear threat credible without also increasing the likelihood that a U.S. president will feel compelled to use nuclear weapons if deterrence fails. Moreover, explicit or implicit U.S. nuclear threats might also increase adversaries' fears of U.S. attacks that directly target their central political leaders in their command bunkers by encouraging them to pre-delegate authority to use weapons of mass destruction to lower level military officers.[43]

♦ Fifth, while part of the objective of the latest Presidential guidance (PDD-60) was to allow the U.S. posture to accommodate anticipated reductions under a START III treaty Russia, the order to plan nuclear contingencies against "rogue" states armed with WMD immediately created inherent obstacles to further reductions in the future. In the study of post-Cold War deterrence from 1995, STRATCOM discovered that expanding the target base globally collided with nuclear weapons reductions. Basically, there would not be enough operational nuclear weapons in the arsenal to cover Russia and China, as well as half a dozen regional troublemakers. STRATCOM's internal review of the pros and cons of reducing the number of nuclear warheads below the START II level of 3,500 recommended *against* deeper cuts partly to maintain enough nuclear weapons for a "broader base to address WMD." Once an addendum to nuclear war planning, targeting WMD proliferators had become a prominent driver and obstacle to deep cuts.

This development is very different from the description Clinton Administration

and Pentagon officials have provided about the changes in the U.S. nuclear posture in the first post-Cold War decade. They talk about reducing the *numbers* and *role* of nuclear weapons but also of reaffirming and maintaining nuclear deterrence as a centerpiece of U.S. national security in the foreseeable future. The main spin they gave on the PDD-60 was that the United States had now removed all requirements that U.S. nuclear forces must prevail in a protracted nuclear war -- a "prudent step" it was said given the changes in the World. The new guidance almost attained an aura of harmony; of being the latest step in the Clinton Administration's plan to reduce further the position of nuclear weapons in U.S. military strategy toward -- eventually -- disarmament.

The role of PDD-60, however, seems to have been to fine-tune arms control objectives with the enduring U.S. nuclear posture. The war-fighters had already designed a flexible force and a planning process that would seem to accommodate whatever guidance might issue from the Presidential pen. For nine years, as each new commitment to arms control reduced warhead numbers, the war-fighters had been happily, and in some cases unilaterally, stripping the Cold War plan of its obvious excesses.

PDD-60 may have removed some references to prevailing in a protracted nuclear war, but it maintained the requirement for a counterforce strategy that continues planning to take out -- in a warfighting manner -- Russian and other opponent's weapons of mass destruction facilities. Although protracted nuclear warfighting may no longer take the form of NATO and Soviet armies throwing large numbers of nuclear weapons at each other on the European battlefield, the U.S. nuclear posture after PDD-60 is still much more than a retaliatory capability, requiring nuclear forces to be upgraded and exercised in pre-, trans- and post-nuclear exchange in the full range of scenarios ranging from a limited pre-emptive strike to major attack options.

Had the President's new guidance unambiguously directed war planners to structure U.S. forces so they would be secure enough merely to deliver a retaliatory blow rather than perpetuate nuclear warfighting capabilities, it would have meant real post-Cold War change. Instead, the nuclear reform that occurred in the 1990s has ensured that nuclear disarmament seems as distant as ever.

Endnotes

[1] Bruce G. Blair, "Global Zero Alert for Nuclear Forces," Brookings Occasional Papers, The Brookings Institution, Washington, D.C., 1995, p. 73.
[2] US Strategic Command, "History of the United States Strategic Command 1 June 1992-31 December 1992," November 5, 1993, p. 80. Top Secret. Partially declassified and released under FOIA.
[3] US Strategic Command, "Strategic Planning Study," Final Report, 1 October 1993, p. 3-1. Partially declassified and released under the Freedom of Information Act.

SIOP-94 changes compared with SIOP-93 included approximately 250 SLBM sortie changes, 116 ICBM changes, and 20 aircraft sortie changes resulting in 20 cruise missile sortie changes. Ibid., p. 3-32.
[4] Ibid., pp. 3-30.

Also see: USSTRATCOM, Briefing by Lt. Col. George Beck, SWPS Program Manager, "Strategic War Planning System," 6 September 1997, slide 11. This document was previously available at the STRATCOM Web Site but has since been removed.
[5] US Strategic Command, "Strategic Planning Study," Final Report, 1 October 1993, p. 3-35. Partially declassified and released under the Freedom of Information Act.
[6] US Strategic Command, "History of the United States Strategic Command, 1 January 1993 – 31 December 1993," Top Secret, pp. 178, 180. Partially declassified and released under the Freedom of Information Act.
[7] US Strategic Command, "History of the United States Strategic Command, 1 January 1994 – 31 December 1994," Top Secret, [n.d.] 1995, p. 42. Partially declassified and released under the Freedom of Information Act.
[8] US Strategic Command, "Sun City," 1993, p. 2. Secret. Partially declassified and released under the Freedom of Information Act.
[9] US Strategic Command, "History of the United States Strategic Command, 1 January 1993 – 31 December 1993 (U)," Top Secret, [n.d.] 1994, p. 62. Partially declassified and released under the Freedom of Information Act.
[10] William S. Cohen, U.S. Secretary of Defense, "Report of the Quadrennial Defense Review," May 1997, n.p. [Section III (Defense Strategy)]. Available online at http://www.defenselink.mil/pubs/qdr/index.html.
[11] William M. Arkin and Robert S. Norris, "Nuclear Alert after the Cold War," Natural Resources Defense Council, NWD 93-4, October 18, 1993, pp. 6, 11 (footnote 38). See also: Bruce Blair, "Global Zero Alert for Nuclear Forces," Brookings Occasional Papers, the Brookings Institution, Washington, D.C., 1995, p. 7.
[12] USSTRATCOM, "Sun City Extended: A USSTRATCOM Study of Future Force Structure Studies," February 1, 1994, slide 39. Secret/WNINTEL. Partially declassified and released under FOIA.
[13] I am indebted to Bruce Blair at the Brookings Institution for bringing my attention to this development.
[14] Bruce G. Blair, "Global Zero Alert for Nuclear Forces," Brookings Occasional Papers, The Brookings Institution, Washington, D.C., 1995, pp. 6-7.
[15] US Strategic Command, "History of the United States Strategic Command, 1 June 1992 – 31 December 1992," Top Secret, [n.d.] 1993, pp. 13, 66. Partially declassified and released under the Freedom of Information Act.
[16] Joint Chiefs of Staff, "1991 Joint Military Assessment," Washington, D.C., March 1991, pp. 7-1 (box), 11-12.
[17] Dick Cheney, US Secretary of Defense, "Annual Report to the President and the Congress," Washington, D.C., February 1992, p. 59.
[18] Gen. Lee Butler, Commander-in-Chief, Strategic Air Command, in US Congress, Senate, Committee on Appropriations, Defense Subcommittee, Hearings on Department of Defense Appropriations for Fiscal Year 1993, Part 2, 102nd Cong., 2nd sess., 9 April 1992, p. 796.
[19] John J. Welch, Jr., Assistant Secretary of the Air Force (Acquisition), and Lt. Gen. John E. Jaquish, Principal Deputy Assistant Secretary (Acquisition), "Presentation to the Committee on Appropriations Subcommittee on Defense. Subject: Air Force Research, Development, Test and Evaluation," 29 April 1992, p. 4; in US Congress, House, Committee on Appropriations, Subcommittee on the Department of Defense, Hearings on Department of Defense Appropriations for FY 1993, Part 6, 102nd Cong., 2nd sess., 1992, p. 318.

In response to congressional questions about why US concern over accidental or unauthorized launches of nuclear weapons had not prompted the government to sign an agreement with the Commonwealth of Independent States to take most or all strategic weapons off alert, Director of the Strategic Defense Initiative Organization Ambassador Henry Cooper stated: "In addition to ballistic missiles of the former Soviet Union and China, we are concerned about those that may be acquired by other countries in the future." Ambassador Henry Cooper, Director, Strategic Defense Initiative Organization, in US Congress, Senate, Committee on Appropriations, Defense Subcommittee, Hearings on Department on Defense Appropriations For Fiscal Year 1993, Part 4, 102nd Cong., 2nd sess., 2 April 1992, p. 346.

[20] Eric Schmitt, "Head of Nuclear Forces Plans for a New World," *The New York Times*, 25 January 1993, p. B7.

[21] Gen. George Lee Butler, US Air Force, Strategic Command, "Statement before the Senate Armed Services Committee," 22 April 1993, p. 3.

[22] Joint Chiefs of Staff, "Joint Nuclear Doctrine," J-3-12, April 1993.

[23] US Strategic Command, "Final Report of the SWPS Modernization Road Map Team (SM-RT)(U)," Secret, August 1992, pp. 3-6, 3-49. Partially declassified and released under the Freedom of Information Act.

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[25] USSTRATCOM, "Strategic Planning Study," Final Report, 1 October 1993, p. 3-9. Partially declassified and released under the Freedom of Information Act.

[26] US Strategic Command, "History of the United States Strategic Command, 1 January 1994-31 December 1994," [n.d.] 1995, p. 64. Top Secret; US Strategic Command, "History of the United States Strategic Command, 1 January 1993-31 December 1993," [n.d.] 1994, p. 165. Top Secret. Both documents partially declassified and released under the Freedom of Information Act.

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[29] Rome Laboratories (US Air Force), "Rome Lab Technologies Supporting Operational Capabilities," 30 November 1997. Available on the Rome Lab Web Site, http://www.rl.af.mil.

[30] US Strategic Command/J51 Memorandum, NPR Report #8, Working Group #5, 4 November 1993, p. 2. For Official Use Only; USSTRATCOM Memorandum, NPR Report #5, Working Group #2, 16 November 1993, p. 2. Both documents partially declassified and released under the Freedom of Information Act.

[31] US Strategic Command/J51 Memorandum, NPR Report #69, Working Group #5, 9 February 1994, p. 1. Secret. Partially declassified and released under the Freedom of Information Act.

[32] Department of Defense, "Listing, Group 5 – Relationship Between US Nuclear Postures and Counterproliferation Policy, Formal STRATCOM Answers as of 22 November 1993," pp. 12, 13. Secret. Partially declassified and released under the Freedom of Information Act.

[33] Department of Defense, "Listing, Group 5 – Relationship Between US Nuclear Postures and Counterproliferation Policy, Formal STRATCOM Answers as of 22 November 1993," p. 14. Secret. Partially declassified and released under the Freedom of Information Act. Emphasis in original.

[34] US Strategic Command, Nuclear Posture Review Slides, Update Briefing, 4 March 1994, slide 3. Secret. Partially declassified and released under the Freedom of Information Act.

[35] US Strategic Command/J51 Memorandum, NPR Report #90, Working Group #5, 7 March 1994, p. 1. For Official Use Only. Partially declassified and released under the Freedom of Information Act.

[36] US Strategic Command/J51 Memorandum, NPR Report #86, Working Group #5, 2 March 1994, p. 1. Secret. Emphasis added; US Strategic Command Nuclear Posture Review Slides, Update Briefing, 25 March 1994, slide 3. Secret; US Strategic Command/J51 Memorandum, NPR Report #92, Working Group #5, 9 March 1994, p. 1. Secret; US Strategic Command, Nuclear Posture Review Slides, Update Briefing, 11 March 1994. Secret. All documents partially declassified and released under the Freedom of Information Act.

[37] US Strategic Command, Nuclear Posture Review slides, Update Briefing, 3 December 1993, slide 7. Secret. Partially declassified and released under the Freedom of Information Act.
[38] US Strategic Command/J51, Memorandum, NOR Report #80, Working Group #5, 23 February 1994, p. 2. Secret. Partially declassified and released under the Freedom of Information Act.
[39] This document is still in effect as of December 1999 and is available online at the Joint Chief of Staff electronic library: http://www.dtic.mil/doctrine/jel/new_pubs/jp3_12_1.pdf.
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[43] These points are thoroughly discussed in Scott D. Sagan, "Should the United States Use Nuclear Threats to Deter Biological and Chemical Weapons Attacks?," *International Review* (forthcoming, early 2000). Cited with permission from author.