Federation of American Scientists

# Missions for Nuclear Weapons after the Cold War

Ivan Oelrich

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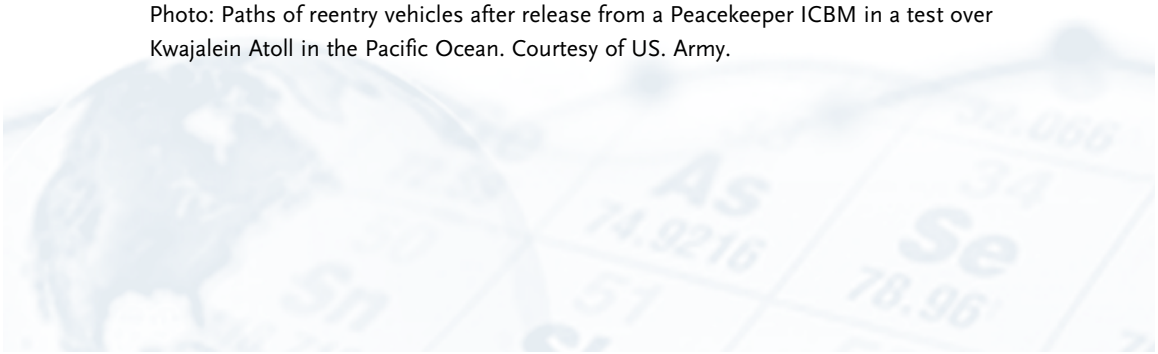
Photo: Paths of reentry vehicles after release from a Peacekeeper ICBM in a test over Kwajalein Atoll in the Pacific Ocean. Courtesy of US. Army.



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Ivan Oelrich
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# Executive Summary

Nuclear weapons are instruments of immense military and political power. Their existence affected every aspect of the Cold War. The appropriate roles of nuclear weapons are less clear now that the Cold War is over and much of the current U.S. nuclear force posture is extrapolated from the past. In spite of the great changes in the strategic environment, the United States and Russia still maintain arsenals of over seven thousand nuclear weapons, most with explosive force equivalent to hundreds of thousands of tons of TNT, and most ready to launch within minutes. During the Cold War, the nuclear arsenals of both the United States and the Soviet Union allowed for substantial overkill and redundancy. Thus, even large quantitative reductions in intercontinental strategic weapons do not have comparable qualitative effects. Even when the United States and Russia move to the two thousand or so weapons envisioned by the SORT or Moscow Treaty, the U.S. nuclear force structure will be a scaled down version of its Cold War arsenal. In addition the United States, and probably Russia, are exploring new missions for nuclear weapons.

This study sets out to evaluate today's nuclear missions. The range of missions for nuclear weapons is being eroded from two sides.

First, changes in the strategic environment, including the end of the Cold War, the collapse of the Soviet Union, dissolution of the Warsaw Pact, the rising conventional dominance of the United States, and the growing non-state threat have reduced the number of missions that might warrant weapons of such enormous power. The stakes involved during the Cold War were for each superpower's survival; for the West, nuclear weapons helped compensate for perceived conventional weaknesses. Nuclear doctrines evolved at a time when So-

viet tank armies were poised west of Berlin. But today, America's conventional superiority stands the Cold War strategic balance on its head. Introduction of nuclear weapons into conflicts around the world will work to the disadvantage of the United States.

Second, on-going advances in U.S. non-nuclear technology allow conventional weapons to supplant nuclear weapons in those missions that remain. During the Cold War, nuclear explosives were developed for use in torpedoes, depth charges, demolition charges, air-to-air rockets and surface-to-air missiles, and for small-unit fire support. One by one, advances in modern sensor-guided munitions have made nuclear weapons obsolete for each of these missions. Perhaps the current emphasis on nuclear attack of deep and very hard targets comes about because it is the last mission, aside from destroying cities, for which nuclear weapons are not obviously displaced by conventional alternatives.

This is not to say that nuclear weapons are not potentially extremely useful for some other militaries. The Chinese military, for example, might be viewed as at the technological level of the U.S. military in the 1960s when tactical nuclear capabilities were at their peak. Indeed, the Chinese might have difficulty sinking an American aircraft carrier in the Taiwan Strait except with nuclear weapons. The relative state of the technical sophistication of the Chinese and U.S. militaries means that nuclear weapons can compensate for Chinese weaknesses and exploit U.S. vulnerabilities.

An additional consequence of the technical development in conventional weapons is the world public's new moral perspective on nuclear weapons. Long established laws of war require that a military's violence be purposeful and directed, and discriminate to the extent practical between civilians and military targets. The line of acceptable behavior depends, therefore, on the state of technology because technical advances change the boundary of what is practical. In World War II, area bombing of cities was generally judged acceptable in the West because area bombing was the best the technology of the day allowed. Yet, while sending fleets of B-17s over Berlin was acceptable then, the same raid over Baghdad in the recent war would be judged to violate the laws of war because technology today allows for vastly greater precision and discrimination. The inexorable trend toward more precise targeting pushes choices toward non-nuclear weapons.

This study examines currently proposed missions for nuclear weapons, evaluating their net contribution to our security. The missions were compiled from reports by the Administration, Congress, the military, the national laboratories, and outside analysts. It examines fifteen missions in all, but some are grouped together. The abbreviated list is below. Many past missions, such as air defense, are not included because no one is proposing them today.

The analysis distinguishes between "missions" and "goals." For example, deterrence is not a nuclear mission. The ability to survive a nuclear attack and strike back at the attacker is the nuclear mission. Deterrence is the goal of that mission.

The Administration has declared four goals for nuclear weapons: assurance, dissuasion, deterrence, and target destruction. This study evaluates nuclear weapons by how well they meet each goal for each mission. That nuclear weapons can destroy most targets proposed for them is not in question. But they must be compared to alternatives, and benefits must be weighed against costs. For most missions, recent advances in precision guidance leave little or no relative advantage for nuclear weapons. The costs of using nuclear weapons, however, are large compared to conventional weapons. Some of these costs, such as radioactive fallout, are incurred on the battlefield. Other costs, such as proliferation incentives, are incurred even if the nuclear weapons are never actually used.

This net assessment of costs and benefits finds few missions for which nuclear weapons are the weapon of choice. In other words, if we search for missions for nuclear weapons, we can always find them; but if we search for weapons to fulfill military missions, then we will only rarely light upon nuclear weapons as the best solution.

**Missions for U.S. Nuclear Forces**

- Survive a nuclear attack on the U.S. or its allies and strike back (for retaliation/deterrence)
- Survive a chemical/biological attack on the U.S. or its allies and strike back (for retaliation/deterrence)

- Increase enemy vulnerability (to discourage proliferation)
- Damage limiting strikes in theater
- Damage limiting strikes against Russian central nuclear forces
- Strike back after regional conventional attack (for retaliation/deterrence)
- Overawe
- Provide virtual power
- Fight/terminate regional wars

The first listed mission, **striking back after a nuclear attack on the United States or its allies**, has deterrence as its primary goal. There is wide agreement that nuclear weapons are appropriate for retaliation for nuclear attack. Nuclear retaliation meets the standards for proportionality and mission importance. However, because the stakes are so much lower now that the Cold War is over, the mission can be met with a small number of weapons. The requirements for deterrence have changed dramatically since the end of the Cold War. A nation attacks another because it expects some benefit, either military, moral, political, territorial, or economic. Retaliation aims to impose costs that are greater than any gain, thereby deterring the initial attack. The Cold War was a confrontation of two hostile, incompatible ideologies, each believing it was a model for the whole world. If the world is the prize, then the retaliator must threaten crippling pain to make seizing the prize seem like a bad deal. In other words, the retaliatory threat must be tied to the stakes involved. With the end of the Cold War, the stakes involved in potential conflicts with traditional military powers are substantially smaller.

Some argue that "rogue" states are not deterrable. Whether they are deterrable or not, retaliation does not really describe the response the United States would make to a rogue state's attack. If, for example, North Korea attacked the United States with nuclear weapons, it would be defeated and occupied. The United States might or might not use nuclear weapons, but using them would not be for anything that could be called "retaliation."

A **damage limiting strike** against Russian central nuclear systems is also an

inherently nuclear mission. This mission makes sense only if the attack comes close to complete success. Conventional weapons might with repeated attacks destroy hard nuclear targets such as missile silos but the mission requires high confidence of destruction on the first strike, which demands the power of nuclear weapons. The Administration argues that it no longer specifically targets Russian nuclear forces, indeed, that the U.S. nuclear force structure is directed as much at Syria or Iran or China as at Russia. Yet none of these potential threats, even from China, requires anywhere near the number of high yield, high accuracy, high alert, long-range nuclear weapons the United States holds. In spite of current doctrine, the U.S. nuclear arsenal looks much as it would if a disarming surprise first strike against Russian forces were its paramount mission.

The Russians depend on a large initial arsenal, combined with hopes that any U.S. attack will not be 100 per cent successful, to insure that an adequate retaliatory force will survive. But this means that the United States daily faces a large Russian nuclear force that could be launched intentionally or by accident.

*This mission, the damage-limiting attack on Russian central nuclear systems, perpetuates the most dangerous characteristics of the Cold War nuclear confrontation.*

So the **damage limiting** mission of U.S. nuclear forces drives not just their current structure; it will shape them even after fulfilling the Moscow Treaty obligations. Even in 2012, the majority of deployed U.S. nuclear weapons will be warheads having hundreds of kilotons of yield sitting atop no-warning, quick-launch, high-accuracy, fast-flying ballistic missiles. These are precisely the sorts of weapons that would be used in a disarming first strike. If the United States were to abandon this one mission, it could, in cooperation with Russia, effect truly meaningful reductions in the world's two largest nuclear arsenals. Moreover, safer, more stable deployment and basing options would become available for Russia as well as the United States. This mission, the damage-limiting attack on Russian central nuclear systems, perpetuates the most dangerous characteristics of the Cold War nuclear confrontation.

Two of the missions that this study calls the **virtual power** mission and the

**overawe** mission have difficult-to-specify metrics. The first is the mission of providing the United States the confidence of a nuclear backstop to allow active engagement in the world. The second is the mission of impressing upon other nations, specifically China, the futility of a nuclear competition with the United States. In both cases, the missions are defined in terms of the effect that, not just power, but nuclear power bestows so they are both intrinsically nuclear missions. The virtual power mission is a remnant of the Cold War in which the United States faced another superpower with formidable forces, both nuclear and conventional. Whatever residual benefit this mission might have must be weighed against the cost of legitimizing to the world the cachet and appeal of nuclear weapons. In any case, the mission can be met with an order of magnitude fewer weapons than in the current or planned U.S. arsenals.

Any benefit from the overawe mission depends on a combination of circumstances that this analysis judges to be improbable, but not impossible. Chinese actions suggest they see some advantage to what they judge to be an adequate nuclear arsenal, perhaps measured by the need to checkmate the coercive use of U.S. nuclear forces in a contest over Taiwan. But their behavior has never suggested that they think checkmate requires matching the United States. Yet keeping large numbers of nuclear weapons for the sake of this hypothetical, potential benefit blocks the lowering of real risks by continuing reductions, along with the Russians, in the world's two Cold War legacy arsenals.

A nuclear response has been suggested as an appropriate **retaliation against chemical or biological weapons (CBW) attack** on the United States or its allies, with the aim of deterring such attacks in the first place. The United States has voluntarily given up chemical and biological weapons, so retaliation in kind is not an option. Biological and chemical weapons are not particularly useful militarily against the sort of well protected military force that the United States would field. But they are effective terror weapons, so this is one case in which nuclear weapons might be more discriminating than response in kind. Certainly chemical attacks and probably biological attacks will be less damaging to the United States than nuclear attacks. So the shock to the country and the expected benefit to the attacker will be less. The retaliatory pain required to deter such attacks should be lower; so such attacks should be handled by the force designed to deter nuclear attack. (This **deterrence** mission is distinct from the **chemical/biological counterforce** mission discussed below.)

The Nuclear Posture Review (NPR) suggests that a U.S. capability and willingness to target enemy weapons of mass destruction (WMD) reduces their utility and can shift a nation's cost/benefit calculus to the point that it will forego development of WMD. The relevance of this mission depends on the extent to which U.S. actions affect regional powers' WMD development decisions. Some nations, for example, Pakistan and India, develop nuclear weapons for reasons largely unrelated to the United States. Other nations such as North Korea and Iran want nuclear weapons in part to deter conventional attack by the United States.

To be successful, this mission requires that the United States has dependable targeting information and that the enemy's easy countermeasures, such as making its WMD mobile or dispersed, are not available. The mission also requires that the possibility, even likelihood, of U.S. nuclear use, even preemptive use, is plausible. The necessary perception of U.S. readiness to use nuclear weapons will tend to legitimize them and to some extent counteract the effect that dissuasion seeks.

Even if these conditions are met and nuclear weapons have some dissuasion effect, they must be compared to conventional alternatives. Remember that for this mission the WMD weapons need not necessarily be rendered impotent, just useless to the proliferating nation. Thus, questions of whether nuclear heat is required to neutralize biological weapons does not necessarily come up (although it is important to the counterforce mission discussed next). Conventional weapons can have the same positive effects with less of the negative effect. So they are, on balance, better suited for this mission.

If dissuasion fails, the United States may find itself in the position of wanting to destroy WMD in a military theater during a conflict. The situation here is complex. The effects of nuclear explosives on stored biological weapons, for example, what would be destroyed and what might be dispersed, are not known for certain. Tests could be conducted with conventional explosives that could answer some but not all of these questions. It certainly is true that carefully contrived situations can be postulated that seem to require nuclear weapons. For example, nuclear weapons would be useful if the enemy digs storage tunnels just beyond the reach of conventional weapons but stops digging before he is out of reach of nuclear weapons. There is no reason to believe any enemy will be so

cooperative.

Digging underground began, in the first place, as a countermeasure to the development of precision conventional strike. Digging deeper is a simple countermeasure to any new U.S. nuclear strike capability (as is dispersion or making the targets mobile). This mission will also require extremely good intelligence or lots of weapons. Nuclear weapons can be used for this mission, but they are likely to have no dependable advantage compared to conventional alternatives in most, perhaps all situations. Yet the full cost of developing a nuclear capability must be borne, including the proliferation pressures inevitable if the United States "nuclearizes" existing conventional missions.

In general, for those missions that can be filled by either nuclear or conventional weapons, a comparison of the costs and benefits of both leaves only a narrow set of circumstances where nuclear weapons are preferred. This is not a surprise; no one suggests that nuclear weapons are the instruments of first choice. Everyone agrees that the overwhelming majority of foreseeable military missions will be met with conventional weapons. "Advocates" of nuclear weapons, who argue for greater consideration of nuclear use, are not arguing for widespread, profligate nuclear bombing. The central debate is between those who want nuclear use to be very rare, and those who want it to be very, very rare. The question is whether the United States should maintain, or even develop, nuclear weapons for those few, special cases where they seem advantageous on the chance that these extraordinary circumstances might arise. This study concludes that the United States should not.

For the missions that can be met by either nuclear or conventional weapons, whatever slight short-term tactical advantage nuclear weapons might provide are outweighed by their long-term global costs. The United States enjoys broad conventional military superiority. Over the last decades, the United States has, moreover, used that conventional superiority to execute a military strategy of forward deployment and conventional engagement that is particularly vulnerable to even primitive nuclear weapons. Anything that tends to conventionalize nuclear weapons and works toward their more likely use works against American superiority and the strategy and interests of the United States.

SECTION 1

# Background & Approach

Although nuclear weapons were never used during the Cold War, they affected almost every calculation of America's security. Now, a decade and a half after the end of the Cold War, the role of nuclear weapons is uncertain. Obviously, some facts have not changed: nuclear weapons are still capable of enormous destruction and are potent political symbols. But what is their place? What military and political missions should they have? This paper evaluates how nuclear weapons contribute to U.S. strategic goals after the Cold War.

There are several possible approaches to examining nuclear missions and force structure. The analysis could start with a limited number of possible U.S. grand strategies or visions for a nuclear future and work backwards to determine how best to create that future world. One world might be, for example, one in which nuclear weapons are substantially reduced in importance and legitimacy. In another, the United States might rely broadly on a robust nuclear arsenal. The future-worlds approach allows evaluation of current decisions, such as whether the United States should develop new weapons. But the approach is analytically unsatisfying because it largely presupposes the answer to the central question of how, or even whether, nuclear weapons contribute to U.S. security.

A second approach would be to consider the limited number of nuclear questions on the horizon in turn: whether the United States returns to nuclear testing, develops new earth-penetrating nuclear warheads, and so on. This approach presupposes a well-developed and well-justified set of criteria by which to judge each nuclear program. But developing those criteria would be the real analytical question.

A third approach would be to consider the widest possible range of military

missions, and then evaluate how various military approaches, including the use of nuclear weapons, could best meet those missions. This approach would create a catalogue of nuclear missions within the overall military and security environment. It is probably the most analytically rigorous approach, but the task is huge. Moreover, this approach is not consistent with, and hence not directly comparable to, how the Bush administration evaluates nuclear missions. The Administration has explicitly decoupled nuclear missions from *specific* threats and has focused on nuclear *capabilities*. Whether it is likely or not, one could imagine that in five years every potential nuclear threat from Iraq, Iran, Libya, even North Korea, could disappear but, using the Administration's approach, U.S. nuclear force requirements would not change.

*The question therefore is not nuclear weapons' effectiveness, but how useful they are compared to alternatives and what are the consequences of their development, deployment, and use?*

This study follows a modified version of the full-blown military analysis above, by considering *currently suggested* nuclear missions. It uses a slightly expanded version of the Administration's strategic goals for nuclear weapons as criteria by which it evaluates each nuclear *mission*. When evaluating nuclear missions, it is important to consider *all* the goals of nuclear weapons, because goals might conflict and create tradeoffs. For example, the United States might try to reduce the attractiveness of biological weapons by developing nuclear weapons that can destroy them, but this may legitimize nuclear weapons and work against efforts to limit nuclear proliferation.

This report's analysis finds that nuclear weapons can, without question, fulfill most (but not all) of the *missions* set out for them. For example, nuclear weapons can effectively destroy targets on the battlefield, although with collateral costs. The question therefore is not their effectiveness, but how useful they are *compared to alternatives* and *what are the consequences* of their development, deployment, and use? For example, a "small" earth-penetrating nuclear weapon clearly produces less radioactive fallout than a bomb over twenty times larger exploded on the surface with the same underground effect; but the fallout could cover an entire city with deadly radiation[1]. So a new small nuclear bomb should

not be compared with an existing large one. Rather the best nuclear alternative should be compared to the best non-nuclear alternative, including indirect attacks that effectively neutralize a target without destroying it.

Analysis must also avoid the fallacy of the last move. One of the most common arguments for new nuclear weapons is to be able to attack currently invulnerable deeply buried targets. But these deeply buried facilities were developed explicitly in response to advances, mostly American, in precision-guided conventional weapons. There is no reason to assume that a nuclear "bunker-buster" would be the last move in that continuing game of measure and countermeasure. Other alternatives would be explored, such as making facilities mobile, disguising them as common civilian facilities, or just digging deeper.

Finally, we must consider nuclear weapons' use within a complete military context. In some cases, such as a disarming first strike against Russian nuclear systems, only nuclear weapons are capable of the required rapid destruction. But in other tactical situations, too much can be made of any one target. If the United States can destroy an enemy's army, navy, and air force, can cut their transportation and communication links, and can bring their economy to a halt, under what circumstances does it risk losing the war because some target remains unbombed?

Nuclear weapons' marginal advantage, their advantage compared to conventional alternatives, must be weighed against their marginal costs to determine their net benefit. In most missions, the marginal improvement in effectiveness, compared to modern precision guided munitions, is small (although some proposed nuclear missions, such as destroying a small cache of enemy nuclear weapons, can be so important that even tiny advantages are worth pursuing). The marginal costs, whether measured along strategic, proliferation, or moral dimensions, are potentially huge. For the vast majority of missions considered for nuclear weapons today, they are not the weapon of choice. For those missions for which nuclear weapons do make a net contribution to the nation's security, a secondary question arises: how many would be needed for that mission and of what type?

Our examination of fifteen missions for nuclear weapons makes clear that some advocates of nuclear weapons have a tool and are looking for uses for it.

But decisionmakers must be particularly vigilant against this tendency. Another fallacy occurs because nuclear weapons come with a Cold War legacy of vital importance, so many are predisposed to exaggerate their contribution to our security today.

Nuclear weapons are unique. We hope not to lose sight of this fact, though this analysis uses normal language to frame the debate. Recent debate has tended to make nuclear weapons seem ordinary. An example is the controversy over "small" nuclear weapons, ones with explosive yields less than the equivalent of ten million pounds of TNT, or one-third the size of the nuclear bomb that destroyed Hiroshima and thousands of times larger than the conventional explosive Oklahoma City bomb. The recent promiscuous use of the term "weapons of mass destruction," to fold together nuclear explosives with far less destructive weapons, is also a source of confusion. The uniqueness of nuclear weapons means that their roles should be assigned sparingly. There are risks associated with use of nuclear weapons and nuclear proliferation that are qualitatively different from any other type of weapon. When we calculate potential advantages of using nuclear weapons, we must balance them against these special risks.

## The post-Cold War nuclear environment

The end of the Cold War transformed the nuclear threat facing the United States. The collapse of the Soviet Union enhanced the world's security immensely by ending a generation-long ideological standoff between hostile nuclear superpowers.

Unfortunately, countering this improvement are regional powers, particularly Iran and North Korea, that have nuclear ambitions and are hostile to the United States, creating a threat that is smaller but more volatile than the Cold War conflict. In addition, smaller states and even non-state terrorist groups are seeking biological, chemical, and other unconventional weapons. Although the majority of analysts agree that it is difficult for terrorists to get a nuclear explosive, it cannot be ruled out. Given the grave consequences, even an unlikely nuclear terrorist threat must be taken seriously.

There is broad agreement that simple numerical changes in the U.S. nuclear arsenal have not been proportional to the great shifts in the strategic envi-

ronment. While the United States and Russia have retired substantial numbers of weapons, more than a decade after the end of the Cold War each country still has a nuclear arsenal large enough to destroy the other several times over. Currently the United States has about seven thousand deployed strategic nuclear weapons, shown in Table 1, each with a yield equivalent to a hundred thousand tons of TNT or more. The Strategic Offensive Reductions Treaty (SORT, or the "Moscow Treaty") will bring the United States and Russia down to about 2,000 deployed warheads. This is a numerically large reduction. But we are still left with weapons far beyond the numbers needed to destroy either country, so the treaty is of less practical effect than the numbers alone would suggest. Moreover, SORT does not require reductions in deployed weapons that are very different from those outlined earlier by Presidents Clinton and Yeltsin for START III. [2] Yet it does allow ill-defined, large, non-deployed reserves of nuclear weapons, some of which could be redeployed in hours. The United States has not announced specific numbers, but has made clear that the majority of non-deployed warheads will be stored, not destroyed,[3] in part to hedge against possible systematic failures in the nuclear arsenal.

**Table 1**
**United States Nuclear Warhead Inventory**

| | Delivery Vehicles | "Accountable" Warheads |
|---|---|---|
| Land-based Missiles | 550 | 1700 |
| Submarine-based Missiles | 432 | 3168 |
| Bombers | 245 | 1100 |
| Total Strategic | 1227 | 5968 |
| Non-strategic | | ~1600 |
| Total | | ~7600 |

Notes: The strategic warhead numbers are "START accountable," and the actual number may be higher. For example, under START each B-52 is assessed 10 warheads although it can carry more. The non-strategic warheads are 1300 B-61 gravity bombs and about 300 air-launched cruise missiles, not all of which are active. See: http://www.nrdc.org/nuclear/nudb/datab11.asp and http://www.armscontrol.org/factsheets/usstrat.asp .

Even those who disagree about what U.S. nuclear force structure ought to be, agree roughly on why the United States has not reduced its nuclear arsenal proportionately to reductions in the threat. Soon after the collapse of the Soviet Union there were suggestions to seize the moment and try for large reductions in nuclear forces. Other voices urged caution, pointing out that liberalizing changes in the Soviet Union, and then Russia, could be quickly undercut and reversed. This reasoning led the first Bush and the Clinton Administrations toward a strategy of "hedging," by deliberately allowing force reductions to lag behind international political changes until the changes were irreversible. As the hostility with the Soviet Union/Russia passed into history, the current Administration developed a nuclear strategy that purports to leave Cold War thinking behind entirely and start with a clean slate; yet the resulting force structure is remarkably close to what would be required to achieve the Cold War mission of a disarming first strike against Russia, albeit with smaller forces on both sides.

Institutional forces are slowing any change in the nuclear arsenal. Though concerns about the threat from nuclear weapons persist after the end of the Cold War, fears of nuclear dangers have lost much of their political urgency. Many follow the easiest political and bureaucratic course, which is to keep what we have, so the nuclear force structure remains in place. Moreover, reductions in nuclear forces would not reduce costs much within the overall defense budget; so there is little financial pressure for reductions that could counter the present institutional inertia.[4]

There is no agreement on what the U.S. nuclear force structure *ought* to be. Several studies have examined possible nuclear futures. These studies tend to fall into one of two schools. One seeks a general de-emphasis of nuclear weapons in U.S. doctrine and corresponding dramatic reductions in the number of nuclear weapons. The other school gives an important role to nuclear weapons and argues for large, robust nuclear arsenals.

Whatever the causes, current plans call for a U.S. nuclear force structure comprised of approximately 2,000 deployed warheads and probably as many non-deployed warheads. Movement toward radical reductions, down to the low hundreds of weapons rather than the low thousands, has stalled. The publicly available parts of the government's most recent Nuclear Posture Review, which

is the Administration's basic nuclear strategy document, seem at first reading to call for nuclear weapons that are flexibly useable. Acceptance of this doctrine may not be a dramatic departure from the Cold War doctrine. It seems to recognize that previous tactical and theater nuclear missions have greater *relative* importance now that their central deterrent role has been reduced. At the same time, the Congress, with strong encouragement from the Administration,[5] recently repealed the Spratt-Furse Amendment, which had prohibited development and some research on nuclear weapons of less than five kilotons. A recent memorandum from the Director of the National Nuclear Security Agency (NNSA) to the Directors of the national laboratories encouraged taking advantage of the Spratt-Furse repeal by aggressively exploring new nuclear weapon concepts.[6]

## Defining Nuclear Missions

This study does not set out to promote new nuclear missions but to evaluate the set of missions currently under some level of consideration. The set is shown in Table 2 and is a composite from several sources, including a report from the National Institute for Public Policy (NIPP), the Nuclear Posture Review (NPR), studies from the National Laboratories, and Congressional reports.[7]

Before proceeding, we need two definitions: *mission* is used here to mean a specific type of task such as destroying a particular type of target. *Why* one might want to destroy the target, the effect, is the objective or, using the Administration's terminology, the *goal*.

The distinction between missions and goals is important but is often muddled in discussions of nuclear weapons. In the following discussion, deterrence, for example, is *not* a mission of nuclear weapons. A *mission* for a nuclear system might be to be able to survive a first strike and then launch against the striker, destroying its cities. The *goal* of this mission would be deterrence. **Damage limitation** seems to be an uncontroversial goal in general; but the specific mission of a surprise first strike, necessary to effect that goal, is much less appealing. Many discussions of nuclear weapons do not maintain the distinction between missions and goals. They assume or assert that nuclear weapons will achieve the desired goal, so some of the missions are only implied. It is easy to lose sight

of the task nuclear weapons would actually be asked to perform. Maintaining this perspective is one benefit of maintaining the distinction between specific missions and general goals.

**Table 2**
**Nuclear Missions**

1 Survive and fire back after nuclear attack against homeland (for retaliation/deterrence)
2 Survive and fire back after nuclear attack against allies (for retaliation/deterrence/assurance)
3 Survive and fire back after chem/bio attack against homeland (for retaliation/deterrence)
4 Survive and fire back after chem/bio attack against allies (for assurance/retaliation/deterrence)
5 Survive and fire back after CBW use in military theater
6 Deploying nuclear weapons to attack enemy nuclear weapons to increase their vulnerability, decreasing their value (to discourage their development in the first place)
7 Deploying nuclear weapons to attack enemy chem/bio weapons to increase their vulnerability, decreasing their value (to discourage their development in the first place)
8 Damage limitation attacks against nuclear weapons in military theater
9 Damage limitation attacks against CB weapons in military theater
10 Damage limitation attacks against Russian/Chinese central systems
11 Ready to inflict damage after regional conventional attacks (or to deter such attacks)
12 Overawe potential rivals
13 Provide virtual power
14 Fight regional wars
15 Apply shock to terminate a regional conventional war

## Nuclear Weapons Missions

We have tried to make the list complete. However, some possible nuclear missions, in fact some actual past missions, are excluded because they are not currently proposed. For example, the Nike and Safeguard systems deployed nuclear warheads for strategic defense against bombers and missiles respectively,

but we can find almost no serious consideration at this time of arming ballistic missile interceptors with nuclear warheads. Indeed, the Congress has even considered banning the option. Nuclear explosives have been proposed as propulsion systems for space launchers (the Orion project, for example) that could have military application but this idea is not currently on the table. We included a mission for discouraging the build-up of nuclear arsenals by making the competition seem hopeless (a mission we call "overawe," that is usually mentioned with respect to China). We do not, however, list a comparable "overawing" mission with respect to discouraging other nations from developing chemical or biological weapons because we cannot find any proposal for it. The list in Table 2 runs roughly in order of more to less widely accepted missions.

## Evaluation Criteria

This study evaluates each of these nuclear missions in the post-Cold War context, though there is heated debate about which evaluation criteria are appropriate. Picking criteria can become a backdoor entry to the "future nuclear world" approach described and rejected above. For example, some start from the assumption that the dangers of nuclear weapons are so grave and evident that the only appropriate criterion is whether the mission contributes to nuclear deterrence, that is, whether it reduces the likelihood of nuclear use. Others argue further that the only appropriate "mission" of nuclear weapons is to point us toward eventual nuclear disarmament, so missions should be evaluated by whether they move in that direction. Those who accept a more robust nuclear policy accept many more criteria to apply to nuclear missions.

Even if we use the criteria of those who advocate a more aggressive nuclear posture, we find that some of the proposed nuclear missions do not meet the goals set for them. These missions can then be moved off the table. Other nuclear missions may satisfy some criteria but not all. We hope this review aids readers' evaluation by whichever set of criteria they choose.

Specifically, this study starts with the Administration's four goals for the nuclear force (as part of a new "triad" of nuclear offensive forces, defenses, and a responsive infrastructure) as laid out in the most recent Nuclear Posture Review (NPR). The purpose of nuclear weapons, according to the Administration, is either to assure, dissuade, deter, or defeat.

The NPR states that nuclear weapons are meant to assure, primarily our allies but also ourselves. Simply possessing a nuclear force gives the United States the confidence to protect itself and its allies against all enemies but especially enemies armed with nuclear, biological, or chemical weapons. The argument is that United States does not even have to contemplate the use of nuclear weapons: just having them provides a solid security foundation for U.S. engagement in the world. Having a U.S. nuclear umbrella large enough to cover allies also reduces their incentive to develop their own nuclear arsenals, the NPR argues, thereby reducing proliferation.

Nuclear weapons should dissuade enemies from attempting certain types of military competition. If the United States maintains, for example, a large intercontinental-range nuclear arsenal, now over a hundred times China's, then China will be content with a small force, it is argued. But if the United States reduces substantially, the Chinese will believe that competition is possible and productive and will respond to U.S. reductions with their own buildup.

Of course, nuclear weapons should deter. This means primarily, but not exclusively, deterrence of *nuclear* attack on the United States or its allies. By threatening retaliation, the United States can make any attack more costly than any possible military, political, or economic gain. To effectively deter, one should be able to threaten something the enemy values.

Finally, the NPR argues that nuclear weapons should be able to defeat, that is, they should be able to engage military targets for military advantage. Of particular importance are targets that may resist attack by conventional weapons, for example, hardened intercontinental-range missile silos.

The Administration's four goals for nuclear weapons provide a broad, but still incomplete, basis for a comprehensive evaluation of nuclear missions. Some may wish to consider even broader goals for nuclear weapons. One example would be coercion. The United States may want to use nuclear threats to force North Korea to dismantle its nuclear program or to force China to withdraw forces from Taiwan after an invasion. Coercion does not fit neatly into any of the Administration's goals but is logically analogous to deterrence. Deterrence depends on a threat that, if you do X, I will respond with Y; coercion is a threat that, if you do *not* do X, I will respond with Y.

The Administration's goals also do not satisfy those who are looking to reduce the role of nuclear weapons. Implicitly standing over its goals is an overarching objective that could be described very generally as "enhancing the security of the United States, its allies, and the world." The presumption of the NPR is that getting closer to reaching each of the four nuclear goals contributes to this highest objective. But some nuclear missions may not contribute to some goals and thus not contribute to the nation's overall security. Some missions might even receive an overall score of zero in their evaluation. Yet limiting the evaluation criteria only to how well the NPR goals are met considers only half the equation. Benefits and *costs* must be compared, not just benefits rated on a scale starting at zero.

Using only the Administration's four goals, it is difficult to evaluate how nuclear weapons might undermine U.S. security, that is, it is difficult to evaluate nuclear missions' costs that can then be compared to benefits. (Many have noted that if nature had tweaked some of the properties of nuclei just a bit, making nuclear weapons impossible, then the security of the United States would have been immeasurably enhanced.) At the very least, we must consider negative evaluation scores. For example, when using the goal of dissuasion as a criterion, we must admit the possibility that some nuclear missions might actually *encourage* enemies to deploy new nuclear weapons, resulting in "negative dissuasion."

In fact, using the goals and presumptions presented in the NPR never gets us on any path leading to a world where nuclear weapons are substantially de-emphasized or de-legitimized. This analysis could add goals and associated criteria such as "reducing nuclear arsenals globally," but, to stay as close as possible to the current NPR structure, it uses the Administration's four goals as the basis for evaluation and expands them to allow for "negative" scores. For example, a U.S. nuclear mission that actually encourages proliferation will get a negative "dissuasion" score. A mission that contributes to first strike instability will get a negative "deterrent" score. The goal of "deterrence" expands to include coercion. In the sections that follow, each of the suggested nuclear missions is evaluated by how well they advance applicable goals.

SECTION 2

# Nuclear Mission Evaluations

This section evaluates each of the nuclear missions by the criteria of how well they meet the expanded NPR goals. Some of the missions, while distinct, are logically very similar. A separate treatment of each one would be redundant, so some missions are evaluated together.

**Mission 1: Retaliation for nuclear attack against homeland**
**Mission 2: Retaliation for nuclear attack against allies**

Nuclear strategists, excepting nuclear abolitionists, agree that retaliating for nuclear attack against the U.S. homeland is the minimum core mission for nuclear weapons. The goal of retaliation, or more precisely, maintaining the ability to retaliate, is to **deter** nuclear attacks in the first place. Indeed, the retaliation mission is often equated with deterrence, as though the two are manifestly the same thing.

There is no agreement on what is required to effect deterrence. Failures of deterrence are obvious, but success means the absence of an attack, which is harder to pin down. Were enemies deterred or did they never really contemplate attack in the first place? Through the crises of the Cold War, nuclear weapons were not used; so we know deterrence did not fail, even if we cannot be certain how well it worked. We do not have empirical data to determine the relationship between deterrence and arsenal size and weapon type.

The vast nation-destroying arsenals of the Cold War grew up in part because of this uncertainty about deterrence requirements but also because the Cold War was viewed as a contest of unlimited stakes. Both sides at one time saw the Cold War as a struggle between two potentially universal ideological

models: liberal capitalism versus authoritarian communism. The prize was the fate of the world. The threat of retaliation will deter aggression if the retaliator can inflict damage that is greater than the value of the prize that the aggressor hopes to seize. If the prize is eventual dominance of the whole world and that is a defining ideological goal, then the threatened damage must be near absolute to deter effectively. If the Soviet Union thought it was in a position to win everything then, to make that a bad bet, the United States had to threaten to destroy everything, that is, end the Soviet Union as a society.[8] Moreover, the ideological contest would not end with the end of the nuclear war; after the nuclear war, the contest was which side could rebuild fastest. One explicit goal of nuclear attacks on the Soviet Union was to destroy it as a society and to put off as far as possible the reconstitution of the threat.[9] Thus, retaliation punishment was, in the extreme, intended to be nation-crushing.

The Cold War nuclear confrontation had some of characteristics of a "zero-sum game." Specifically, in a contest of global domination, our enemy's loss appears to be our gain; if we suffer losses but he suffers even greater losses, then we still come out ahead if the only thing that is important is the *relative* balance of power in the world contest. The Cold War theories of nuclear strategy were developed within this context of zero-sum confrontation of unlimited stakes. With that combination it is tempting to isolate the nuclear exchange and examine gains and losses from just the nuclear part of a possible war. The resulting hypothetical nuclear exchanges, in turn, lend themselves to numerical and game theory modeling that is further divorced from a broader political and military context. In such theoretical models of wars between the U.S. and Soviet (now Russian) arsenals, it seems that deterring a 1,000 warhead attack requires an 1,100 warhead retaliation. Otherwise, the enemy will be "ahead," having inflicted more damage on us than we have on him in a global fight to the death.

What has *not* happened since the end of the Cold War is a recalibration of our deterrence requirements based on the changes in the *stakes*. The Cold War analyses of nuclear wars took little regard of what the war might have been *about*, implicitly assuming it would be about national survival and world leadership. Today the stakes are, overall, much smaller. Indeed, it is nearly impossible to conjure up even hypothetical areas of conflict between the United States and Russia with stakes remotely comparable to those of the Cold War or even a crisis that could rationally justify nuclear weapons. Where the stakes are

high–for example, the ongoing tension between Islamic fundamentalism and the West–the role of nuclear retaliation is limited.

The size of the U.S. force needed for retaliation should be proportional to the stakes involved, not to the putative enemy's arsenal. Imagine a war about some issue that leads to nuclear exchange, then ask how many nuclear weapons would have to be launched in each direction before the leaders of both sides say, "Whatever the fighting was about, it isn't worth *this*." If the fight is about the survival of freedom in the world, then the answer might be a frighteningly high number of weapons; indeed, many in the free world might choose to fight to the end rather than accept defeat. But what would the number be if the issue in question were road and rail access to Kaliningrad? If handled badly, such a crisis could lead to war between NATO and Russia. But would the Russians launch a half dozen nuclear weapons at the United States and NATO, then receive as many in return, and think that was a price worth paying even if the crisis resolved in its favor? Compared to the damage even a few nuclear weapons can cause, the original crisis would pale. When compared to the stakes involved, rather than enemy arsenals, the United States probably needs scores rather than thousands of nuclear weapons to meet its post-Cold War goals of deterrence.

*The size of the U.S. force needed for retaliation should be proportional to the stakes involved, not to the putative enemy's arsenal.*

The retaliation mission can be met by a wide range of types of nuclear weapons. The most basic goal is to deter by threatening to inflict enough pain to make an initial attack unappealing. Any nuclear weapon that reaches its target and explodes can do that. Attacking cities and the people they house is an obvious way to impose costs on a nuclear foe, but the doctrine presents severe moral problems, which undermines its credibility, which is essential to deterrence. Some have suggested that attacking physical plant without attacking people directly can solve this conundrum. Essential yet vulnerable economic targets abound, for example power stations or oil refineries. The nuclear war will inevitably be part of some other conflict, most likely involving conventional forces, and a nuclear strike may try to combine the punishment of retaliation

with some tactical advantage by attacking conventional military targets or their logistic support. Even this more constrained set of targets is not challenging for nuclear weapons. We must keep in mind that the mission of simple retaliation with the aim of deterring involves inflicting some costs, or pain, on the attacker. Thus, weapons like "mini-nukes" or earth penetrating warheads, which seek to achieve military ends with minimal collateral damage, reduce the pain inflicted and might be less effective deterrents. These weapons are, therefore, discussed in the section on war-fighting.

While the deterrence of Russia, the former Cold War enemy, may have become easier, new deterrence challenges have grown in relative importance since the end of the Cold War. Smaller nuclear newcomers may play by different, and difficult to understand, rules. These states are often lumped under the label "rogue" and while there is not a widely agreed definition of "rogue state," the term is used generally to mean a state that is outside the normal bounds of international behavior and specifically, and most importantly here, is not reliably deterrable. The exemplar of the class is North Korea, with Syria and Iran usually included and also, until recently, Afghanistan, Libya and Iraq. There is debate about whether these states are deterrable or not. Some argue that no one becomes a despotic leader without paying careful attention to his own survival. Thus, while leaders like Kim Jung Il and Saddam Hussein may be grossly indifferent to the welfare of their people, they care very much about maintaining their own positions and are, therefore, deterrable.[10] In fact, Saddam was not deterred from invading Iran and Kuwait, and not coerced before the most recent war, because the relevance of U.S. power remained ambiguous in his mind.

The problem is that only failures of deterrence are obvious. So we may never know how deterrable such states are. But these two diametrically opposed possibilities, either easily deterred or impossible to deter, may make little difference to the retaliation mission. If threats of retaliation do not deter nuclear use by these states, then we can put the retaliation mission aside because no force, large or small, will be effective. If the opposite theory is correct, that the leaders of "rogue" states are easily deterrable, then quite small retaliatory forces targeted on the instruments of regime control and survival should be adequate. Indeed, since all of these states have small conventional capabilities compared to those of the United States, nuclear weapons might be superfluous to deterrence. Thus, whichever theory is closest to the truth, the retaliatory forces needed

range from zero to small. (Of course, some argue that if these regimes cannot be deterred, the United States needs instead robust counterforce weapons, discussed below.)

The deterrence of some states might be questionable but sub-state groups such as al Qaeda are almost certainly not deterrable through threats of nuclear retaliation, not because they would not be deterred by retaliation against targets they value, but because finding such targets is difficult and the targets almost certainly would not be best attacked with nuclear weapons. Consider, for example, if al Qaeda bought a nuclear weapon from corrupt government officials or military officers in Russia or Pakistan and then detonated it in the United States. There are numerous targets that the United States could certainly attack in response, but it is very difficult to come up with targets that require nuclear weapons.

At the end of the spectrum, deterrence blends into **compellance**, that is, not just deterring an unwanted action but forcing some action the United States does want. For example, if the Chinese occupied Taiwan in a lightning invasion before the United States could react, it might then want to force the Chinese to withdraw by threatening nuclear attacks if they failed to withdraw. However compellance works out in theory, blunt retaliatory weapons that might be appropriate to deter attack on the U.S. homeland are probably not those most appropriate to compellance, because United States' first strikes against China will invite Chinese retaliatory strikes in kind. The United States is far more likely, therefore, to first threaten attacks against a severely constrained set of targets, for example the mainland loading docks and airports needed to supply forces occupying Taiwan. Therefore, compellance is discussed later when tactical nuclear missions are covered.

Having a reliable retaliatory force **assures** the United States, allowing confident international engagement. Against a non-nuclear adversary, the United States might suffer major tactical defeats, but national military defeat is not plausible. Having a nuclear retaliatory capability also allows the United States to engage other nuclear powers. In theory, by checking an enemy's nuclear threats and removing nuclear weapons from the equation, the United States can confidently exploit its conventional military advantage.

The assurance of nuclear weapons is tempered, however, by the combina-

tion of asymmetry of stakes and the enormous costs that nuclear weapons can so easily impose. For example, the United States might see a military confrontation with a smaller country as part of some limited regional problem, while the smaller country sees it as a matter of national survival. If the regional power attacks the United States with nuclear weapons, then even a devastating U.S. retaliation is not going to make good the damage already done. Some strategists have argued that because of the asymmetric view of the stakes involved, the United States must threaten a disproportionate response.

*Much fine tuning of the arsenal, such as putting into Europe U.S.-controlled Pershings and ground-launched cruise missiles that could reach the Soviet homeland, was designed to tie the deterrence offered by central U.S. strategic forces to the defense of Europe.*

Retaliatory capability should assure U.S. allies as well. It should assure them that their enemies will not attack them with nuclear weapons, because the United States will retaliate on their behalf. It should assure them that the United States has the confidence to come to their aid with conventional forces, not being frightened away by nuclear threats. Perhaps all that is needed for the assurance mission is for U.S. nuclear forces to negate enemy nuclear forces so wars can be decided by conventional weapons.

During the Cold War, deterring nuclear attack against NATO Europe was integral to Western defense. Much fine tuning of the arsenal, such as putting into Europe U.S.-controlled Pershings and ground-launched cruise missiles that could reach the Soviet homeland, was designed to tie the deterrence offered by central U.S. strategic forces to the defense of Europe. We should not forget the context of the Cold War debates about deterrence. Much of the concern regarded not the credibility of retaliation for attacks on the U.S. homeland (most analysts thought that could just be assumed) but the credibility of linking U.S. retaliation to Soviet conventional attack on Europe. It was to ensure that link that the United States developed doctrines of escalation dominance and deployed weapons that allowed at least some threat of a first strike against Soviet central nuclear systems.

Extending deterrence to allies may be more difficult now because the stakes are lower and the credibility of U.S. threats of retaliation may be less. On the other hand, because the stakes are smaller, the numbers of weapons needed for extended deterrence should be much smaller than the number that was required to extend deterrence to NATO Europe during the Cold War. And increasing the number of U.S. nuclear weapons does not increase the credibility of the response. For example, the Russians might someday bully the Latvians because they are mistreating their Russian-speaking minority. But the resolution of that conflict is less important to Moscow than was the Cold War status of Europe; presumably the threats needed to discourage the Russians can be proportionately smaller, and almost certainly no longer need to be nuclear. Also, if the enemy is a smaller country, such as Iran or North Korea, the number of plausible targets is smaller than those in a large country like China or Russia.

Extending deterrence against nuclear threats might be effected through a statement of goals, such as destruction of any regime that uses nuclear weapons, with the means left unstated but without specifically excluding nuclear weapons. Of course, for that threat to weigh in a deterrence calculation, it must be coupled to an implicit assumption that the United States will not seek regime destruction in a conflict with a nation that does not develop or use nuclear weapons. Otherwise, states will see no difference in pursuing nuclear and nonnuclear options. This is a heavy price to pay. The United States would have to forego regime change in places like Panama, Haiti, Nicaragua, Liberia, Grenada, and Yugoslavia, even Iraq, to create a carrot to discourage nuclear proliferation. The nuclear ambitions of just a few states would constrain U.S. power all over the globe.

Our assurance of allies should reduce pressures on allies to produce their own nuclear weapons, but the record of success is mixed here. Britain and France developed nuclear arsenals regardless of explicit or tacit U.S. nuclear guarantees. On the other hand, allies who faced or face potential nuclear threats, Germany, Japan, Taiwan, and South Korea, have not developed nuclear weapons even though they certainly have the technical resources to do so. Neutral Sweden and Switzerland have the technical capability to produce nuclear weapons, face potential nuclear threats, and do not enjoy explicit U.S. nuclear assurance, but neither one developed nuclear weapons. While a U.S. retaliato-

ry capability has, no doubt, had an important effect on each nation's decisions about developing its own nuclear weapons, U.S. capability alone clearly does not overwhelm all the other particular consideration of each country. Moreover, experience from the nuclear age provides almost no insight into a quantifiable relationship between the size of the U.S. retaliatory force and the effects on allied proliferation. If the United States had had an arsenal twice as large, would Israel not have built nuclear weapons? Or if only half as large, would Japan have gone ahead with a nuclear program? Couching the questions in these terms at least suggests that there is at best a weak quantitative link between U.S. arsenal size and other nations' nuclear decisions

It is also unclear how much a U.S. retaliatory capability **dissuades** other countries from deploying nuclear weapons. Dissuasion is like deterrence in that failures are obvious but successes not. The Soviet Union went on a crash program to develop its own nuclear weapons as a counter to U.S. capability, so the U.S. arsenal did not "dissuade" it but may have accelerated Soviet developments. It seems almost certain however that the Soviet Union would have built nuclear weapons eventually whether the United States had them or not, suggesting that the U.S. arsenal affected the "when" more than the "whether" in Soviet decision-making. China's nuclear calculus might have weighed the Soviet Union as heavily as the United States.

There is also little evidence that the U.S. retaliatory capability dissuades lesser powers. (There is an additional argument that a counterforce capability, discussed below, dissuades, but that is in addition to the retaliatory capability considered here.) Again, there is the observational bias that only failure to dissuade is obvious. Nevertheless, there have been some failures. Iran, Iraq, North Korea, and Libya have shown various degrees of interest in pursuing nuclear weapons. While the Iranian and Iraqi nuclear programs predated hostile relations with the United States, the North Korean and Libyan programs were in part intended as counters to U.S. power. Given the United States' ability to utterly obliterate them in a nuclear retaliatory strike, pursuing a nuclear programseems irrational viewed in isolation. Part of each country's motivation is, of course, regional and independent of the United States.

Perhaps another part of the answer is, ironically, that the United States is already so powerful. Smaller powers know that the United States can destroy

them with conventional forces, so bringing down on themselves the additional threat of being defeated by nuclear forces is less fearsome than it might appear. If military risks are not increased, then even marginal benefits of nuclear weapons can tip the balance. These benefits include the ability to threaten heavy U.S. casualties in the hope of giving the United States pause before considering a military intervention. Given the overwhelming conventional military advantage the United States has in most of the world's theaters, costs other than increased military risk must be imposed to discourage nuclear programs.

If the power of nuclear dissuasion is reduced when a smaller nation considers U.S. total forces, then perhaps the dissuasion effect of nuclear forces could be increased by linking crisis outcomes to the possession of nuclear weapons, just as for deterrence discussed above.

Retaliatory forces clearly must be able to **destroy** or defeat at least some enemy targets if they are to inflict sufficient pain. The premise of retaliation is to be able to threaten to punish by destroying something of great value to a potential aggressor. At least during the earlier years of the Cold War, the targets of a retaliatory strike were cities, which are easy to destroy (and the smallest targets that could be hit, given the inaccuracies of early missiles). Cities certainly met the requirement of being valuable. But today attacking civilian-filled cities with nuclear weapons is so problematic that it reduces the credibility of the threat. Thus, there have been attempts to find other, more specific targets for retaliatory forces. Suggestions have included nuclear forces, political leadership, or specific economic targets. If the point of retaliation is to punish, then the question is not whether the forces can destroy any *particular* target but whether they can destroy *some* targets that cause enough loss to the enemy. With nuclear weapons, this is an easy goal to achieve.

**Mission 3: Retaliate for CBW attack against homeland**
**Mission 4: Retaliate for CBW attack against allies**
**Mission 5: Retaliate for CBW use in military theater**

Nuclear retaliation can **deter** non-nuclear attacks on the United States and its allies. Deterring CBW attacks on the United States, its allies, or its military forces is logically and analytically equivalent to deterring nuclear attack. There are differences of degree, of course. The fundamental difference is that most

plausible chemical and biological attacks will be far less damaging than nuclear attacks. An unfortunate semantic trend is the ever widening definition of "weapons of mass destruction." The term has been applied to truck bombs and cyber-attacks. The profligate application of the WMD label threatens to obscure the huge difference between the truly horrific effects of nuclear weapons and everything else. When compared pound for pound, the difference between nuclear weapons and CBW is even greater. Nations reserve their most expensive delivery systems for what they judge to be their most powerful weapons, and they load their intercontinental ballistic missiles with nuclear warheads, not chemicals or biological weapons. (Although a single attack with some hypothetical future *infectious* biological agents, for example, vaccine-resistant smallpox, might be even more destructive than a single nuclear attack. Under certain conditions, anthrax attacks can also result in huge numbers of deaths.[11])

When analyzing how to deter a CBW attack, we first need to understand what its purpose might be. CBW attacks against the U.S. homeland would presumably have much the same motivation as nuclear attacks: to impose high enough costs on the United States to shock it into withdrawing from some contest, or at least to demonstrate the attacker's seriousness. A retaliatory threat forestalls the attack if the attacker's expected costs imposed by retaliation outweigh the expected benefit of the attack. A CBW attack will almost certainly be less damaging, hence less shocking and less likely to alter U.S. behavior, than a nuclear attack. So the attacker's expected benefits, or the expectation of a given benefit, will be less and the costs that need to be imposed on the attacker to offset the benefits will be less. Whatever the nuclear retaliatory capability needed to deter nuclear attacks is, therefore, sufficient to deter CBW attacks.

One problem with using the threat of nuclear retaliation to deter CBW attacks on the homeland is not that nuclear weapons are inadequate to the task, but that they are excessive, thus raising the question of the proportionality, and hence the credibility, of their use. Another perspective on the problem of proportionality is to consider what is proportionate. Against non-nuclear attacks, conventional military responses probably are adequate, and the United States has immense reserves of conventional military power. Most nations are usually effectively deterred from attacking the United States without even considering the possibility of a nuclear U.S. retaliation. Viewed in context, the question is not the utility of nuclear weapons in deterring CBW attack, but the relative ad-

vantage of nuclear retaliation when compared to alternatives. The attractiveness of nuclear weapons as retaliatory weapons is squeezed from both sides: as the importance of the action being deterred becomes less threatening, nuclear use becomes less credible, while non-nuclear weapons become more effective. The relative advantage of nuclear weapons quickly disappears.

Questions about the plausibility of nuclear retaliation against CBW attack is one motivation for developing smaller warheads. Reducing their effects, so the argument goes, increases the credibility of their use, hence increasing their deterrent value, that is, making them better at deterring aggression in the first place. Stated in its simplest form, this is an argument that making nuclear weapons more likely to be used makes them less likely to be used, what we call the "more is less" argument. Because the arguments for increasing the usability of nuclear weapons to reduce the likelihood of their use applies to the retaliation mission against either nuclear weapons or CBW, the mission of discouraging nuclear and CBW development, and nuclear war-fighting missions, and because the discussion is technical and mathematical, we cover it in the Appendix. To summarize, the "more is less" argument requires that increases in "usability" result in decreases in the likelihood of a crisis that more than make up for the increased likelihood of nuclear use in the crisis. The overall likelihood of nuclear use goes down with increased usability only if there are very strong links between threatened nuclear use and crisis deterrence, stronger indeed than we judge most people are willing to believe. We conclude that increasing the "usability" of nuclear weapons will, as common sense suggests, make them more, not less, likely to be used.

*We conclude that increasing the "usability" of nuclear weapons will, as common sense suggests, make them more, not less, likely to be used.*

Even if the "more is less" argument is wrong does *not* mean that threats of retaliation with nuclear weapons will fail to deter, which is, after all, the mission goal being considered here. A greater willingness to use nuclear weapons, indeed, their occasional use, might indeed give potential aggressors additional pause but then we must consider the costs of the increased use. The routine use

of nuclear weapons will most likely earn negative scores for deterring nuclear weapons, because we cannot expect that only the United States will routinely use them. Using nuclear weapons in response to CBW attacks may increase the deterrence of CBW attack at the cost of increasing the likelihood of later nuclear use. Routine use will more broadly legitimize nuclear weapons, earning negative dissuasion scores as other nations try to obtain them.

This discussion has thus far implicitly considered retaliation for CBW attack on the U.S. homeland. The logic is much the same for evaluation of the mission of retaliating for *CBW attacks on allies*. As with homeland attacks, the effect of CBW attacks on allies will be less than nuclear attacks, so whatever retaliatory pain is adequate for nuclear deterrence is adequate for CBW deterrence. The credibility of nuclear retaliation is more of a problem in the case of attacks on allies, because self defense may seem to better justify U.S. nuclear retributive attacks than do attacks on allies.

Using the threat of nuclear retaliation to deter *CBW attack on U.S. military forces* is qualitatively different from deterring attacks on the homeland or on allied civilians. Nuclear weapons would be enormously destructive whether used against civilian or military targets. Chemical and biological weapons, in contrast, could be devastating if used against civilians but would not be particularly useful against a well-prepared military force, such as one the United States would deploy. Constant protection against CBW attack slows down a military operation but with modern protective gear, a military force can operate in a contaminated environment for extended periods and the number of casualties should be low for a disciplined force. While chemical attacks are effective as harassment, if the goal is to destroy a prepared military force, high explosives are, pound for pound, probably more effective than chemicals. Thus, the question of proportionality is moved to the fore. The United States would be retaliating not so much because of the military effect of the weapons but because of the stigma of their use. (Recall that we are discussing the retaliation mission, not the counterforce mission, discussed below.) Thus, if the United States were to make a policy of retaliating with nuclear weapons if CBW is used against its military forces, it would be using militarily devastating weapons in response to militarily ineffective weapons. Nuclear weapons should, therefore, easily deter military CBW use *if* their use were credible. We should remember that U.S. forces advanced from Kuwait to Baghdad wearing chemical garb almost all the

time, with masks, gloves, and boots at the ready. Many false alarms caused U.S. forces to go to full protective garb; yet the advance continued. The results of a CBW attack on U.S. military forces almost certainly will not warrant a nuclear response.

The same arguments could be applied to any military attack on U.S. forces. If attacked with conventional weapons, the United States could routinely and reliably retaliate with nuclear forces and probably thereby deter conventional attacks, but no one seriously proposes this. And not because it would be ineffective in achieving its proximate goal of deterrence, but because of the other costs that such a policy would incur, such as encouraging the proliferation of nuclear weapons and increasing the long-term risk of nuclear attack on the United States. In the language of our criteria, a positive deterrence score is outweighed by a negative dissuasion score.

It is interesting that we can find no one who proposes a chemical weapon response to chemical attacks on U.S. or allied military force. While nuclear weapons are still considered by some to be weapons that one can at least consider using, chemical weapons are apparently beyond the pale. But a symmetric use of chemicals might strongly favor the U.S. military because survival in a chemical environment requires discipline and attention to protocol, which in turn demands high levels of training. The United States has the best trained military in the world and would almost certainly suffer less in a chemical environment than any foes. Chemical clouds would not necessarily disperse any more widely than radioactive fallout and would decay more quickly in the environment, allowing more rapid return to contaminated areas. Differences in the effects and uses between chemical and nuclear weapons cannot explain why chemical weapons are condemned on moral and humanitarian grounds more than nuclear weapons.

**Mission 6: Deploying weapons capable of attacking enemy nuclear weapons to discourage their development**
**Mission 7: Deploying weapons capable of attacking enemy CBW weapons to discourage their development**

This set of missions is supposed to **dissuade** weapons development. It is distinct both from the retaliation mission above intended to deter and from the

damage limitation mission discussed below. The logic behind dissuasion is that, if the United States develops nuclear weapons that can easily destroy nuclear weapons or CBW or whatever it wishes, then there is little advantage to having nuclear weapons or CBW and potential enemies will not pursue their development in the first place. This is, therefore, explicitly *not* a retaliatory mission, but a mission to have the apparent ability and intent to dig out and defeat CBW or nuclear weapons before they are used (although, perhaps after first use of some CBW or nuclear weapon by the enemy). The technical requirements for meeting the mission are almost identical to the counterforce missions discussed next, and the technical discussion is more appropriate there.

*The only nuclear arsenal in the world that is even remotely focused on being able to attack the United States' nuclear arsenal or to survive an attack from it, is Russia's and the Russian/Soviet arsenal was built up despite a clear U.S. focus on trying to be able to destroy it.*

The main difference between this mission and damage limitation is that the United States hopes to use the threat of effective future employment to **deter** behavior (specifically development and deployment) rather than using actual employment to destroy weapons. Just as the advent of naval aviation made battleships so vulnerable that nations eventually stopped building them, if the United States builds weapons that can destroy enemy CBW and nuclear weapons at will, potential adversaries will not even bother to try.

Several conditions must be met for this mission to be relevant and several more must be met for it to be successful. The nation in question must be deterred by U.S. potential and not motivated by other security concerns. India, Pakistan, and Israel developed their nuclear weapons without regard to whether the United States could destroy them. The structure of China's nuclear arsenal suggests that it is more concerned about Russia, and perhaps India, than it is about the United States. The only nuclear arsenal in the world that is even remotely focused on being able to attack the United States' nuclear arsenal or to survive an attack from it, is Russia's and the Russian/Soviet arsenal was built up despite a clear U.S. focus on trying to be able to destroy it.

We put aside until the next section on damage limitation the technical questions about whether deeply buried targets can be found and destroyed. This mission must assume that they can be and, moreover, that an adversary will forego weapons development rather than pursue more survivable deployment. History suggests the opposite. The global move toward deep underground weapon storage is itself a direct result of advances, primarily by the United States, in precision bombing. There is no reason to believe this is the last iteration in the ongoing process of measure and countermeasure. Nations may go ahead with weapons development and simultaneously pursue new survivable basing, for example, by dispersing weapons or just digging deeper.

Effectiveness of this mission also requires that adversary nations believe there is some chance that the United States will attack their CBW and nuclear weapons when they are able. Specifically, if they choose some form of dispersion to enhance survival of their forces, then the United States must be willing to consider attacking the forces when their locations are known. This may require U.S. first strikes with nuclear weapons. Indeed, it may require that the opening move of the war be a U.S. surprise nuclear attack, striking weapons before they can be dispersed and deployed. In preparation for battlefield use, many types of weapons would be deployed among combat units and these could be attacked with either nuclear or conventional weapons. Thus, for this nuclear mission to be effective, adversaries must believe that it is at least possible that the United States will pursue an aggressive nuclear policy that includes either nuclear first strikes, which might force early dispersal, or nuclear attack on dispersed forces. Whether the United States actually follows such a policy, it will have to convince adversaries that it is, in fact, doing so. Furthermore, the costs of crisis instability, for example inducing adversaries to set very low thresholds for dispersal of nuclear and CB weapons or delegation of launch authority, will be incurred whether or not the United States actually plans on a tactic of early preemptive strike. This mission will, therefore, receive negative allied **assurance** scores and negative **deterrence** scores.

Deterrence is a matter of trying to nudge a potential adversary's cost/benefit calculations in such a way to push him away from making an undesired decision. When this dissuasion mission is evaluated from that perspective, we must ask how a nuclear capability makes any *additional* change to the existing deter-

rent calculus. Certainly, if a country uses nuclear weapons against the United States, there is a near certainty that the severest possible retribution will follow. This must already figure into any nation's calculation of the utility of nuclear weapons. While impossible to quantify, the additional disincentive coming from any U.S. targeting capability is probably small. We must also consider how assigning this mission to nuclear weapons changes an adversary's calculation when conventional weapons can accomplish the mission as well, or as poorly.

**Mission 8: Damage-limitation attacks against nuclear weapons in military theater**
**Mission 9: Damage-limitation attacks against CB weapons in military theater**

This set of missions seeks to limit the damage that enemy CBW and nuclear weapons can do by **defeating** them before they can be used. This mission seems to be the single most important, or at least the most common justification, for development of new "small" and earth-penetrating nuclear weapons. These new nuclear weapons are sometimes presented as generic "bunker busters," including such targets as command centers, for example, but when specifics are included, chemical and biological weapons in particular are likely to be cited.

The damage-limitation missions are the ones for which the technical feasibility of the missions are most questionable. One might debate forever whether destroying cities is an appropriate form of retaliation but no one doubts that nuclear weapons could do it. There is, in contrast, considerable uncertainty regarding the identification of targets, the effectiveness of nuclear weapons attacking hard targets, and the consequences of such an attack.[12] The details of the technical effectiveness of these missions become especially important when the goals demand near total success. If the goal is to eliminate 100% of an enemy's stockpiles of some infectious biological agent because even a small release is potentially catastrophic, then there is a big difference between 95 percent effectiveness and 100 percent effectiveness, certainly a bigger difference than between, say, 50 percent and 55 percent effectiveness.

Current discussion of this mission focuses on three issues: first, the proliferation of CBW and, to a lesser extent, nuclear weapons; second, the world-wide

move to build deep underground hardened bunkers to protect these weapons; and, third, the collateral effects of attacking these targets with existing U.S. nuclear weapons. The number of states with active chemical weapon programs is probably less than during the Cold War; several states party to the Chemical Weapons Convention have pledged to eliminate existing weapons programs; certainly Iraq and probably Libya and eventually Russia can be removed from the list[13]. Chemical weapons proliferation may be another example of a problem that appears to be a new post-Cold War phenomenon which, on closer examination, was present all along but was overwhelmed by, or included within, other security concerns during the Cold War and now has come into focus. The situation with biological weapons is more worrying. In that case, there are ongoing proliferation pressures and some technical advances in genetic manipulation that make biological weapons an increasing concern. Regardless of whether the number of threats is moving up or down, it is undeniable that the United States is now more concerned than previously about the threats of biological and chemical weapons.

Advocates of this nuclear mission are not just concerned about the proliferation of CBW but about the mere existence of the deeply buried or very hard bunkers where these weapons might be stored. Some fear that if any enemy can have any asset that is invulnerable it could change the outcome of the war.[14] The United States has large-yield nuclear weapons that can be exploded on the ground to collapse underground storage bunkers. Nevertheless, some very hard or very deep targets may be immune to attack from large nuclear weapons. Combined with worries about collateral effects of large nuclear weapons used in a confined theater war, this new class of deep targets might become, if not invulnerable, effectively immune to attack. These enemy sanctuaries motivate deployment of new nuclear weapons to attack them. In the rest of this section, we discuss this "counterforce" mission in terms of these specialized weapons.

When reviewing the public debate about this mission, we must counter any statement about the effects and effectiveness of nuclear weapons with the question, "Compared to what?" It is true that specialized smaller nuclear weapons might be just as effective as large weapons in destroying underground bunkers and would have substantially reduced collateral effects. This does not mean that the collateral damage, particularly radioactive fallout, will be small; it would only be smaller than that of a ground-burst weapon up to twenty times

larger with the same effectiveness. The name "earth-penetrating" warhead gives the wrong impression, because these warheads will not penetrate deep into the ground to explode inside an underground bunker.

There are two reasons to get a nuclear warhead into the earth. The first is to get the warhead inside of, or extremely close to, a storage bunker so the fireball will destroy the contents of the bunker, for example anthrax spores. The second reason is to get the warhead buried deep enough into the ground so the energy of the bomb goes into shock waves in the earth rather than in the atmosphere. It is the shock waves, not the bomb, that can penetrate deeper into the earth and collapse underground cavities. For a weapon of several kilotons, this is accomplished if the warhead penetrates just a few meters[15]. While such shallow penetration dramatically improves the energy coupling into the ground, it is entirely inadequate to confine the radioactive debris of the explosion. Indeed, under most combinations of soil, depth, and yield, the explosion will create a crater and a large radioactive debris cloud. Thus, compared to current nuclear weapons, the direct, nuclear collateral effects will be smaller, but compared to current and future conventional alternatives, the collateral effects will be much greater.

Are nuclear weapons more effective than conventional weapons at destroying buried targets (putting aside the collateral effects)? It is true that certain combinations of rock and burial depth are immune to conventional attack but can be attacked with nuclear weapons. But the current trend toward deep underground bunkers was motivated by developments in pinpoint bombing that made surface and shallow targets too vulnerable. If nuclear bunker busters make these underground facilities themselves vulnerable, potential target nations can develop other countermeasures, such as dispersing weapons widely or making them mobile; this increases the vulnerability to conventional attack, of course, so it may have some advantage. Nevertheless, there is nothing about nuclear weapons that changes the attractiveness of digging. In the face of nuclear "bunker busters," other nations can be expected to respond the way they did to guided bombs, by continuing to dig deeper until they are safe from nuclear attack as well. The digger will always win this competition for several reasons. First, the depth of destruction of a nuclear weapon goes up only as the third root of the yield. For example, to destroy ten times deeper requires a bomb a thousand times more powerful. While under most circumstances digging deeper is

closer to a linear problem, that is, digging down two hundred meters is about twice as hard as digging one hundred meters. (This rule breaks down at extreme depth where the overpressure of the rock above approaches the strength of the rock walls of the tunnel, in other words, when the tunnel can barely support itself it becomes more both more difficult to dig and more vulnerable to additional shock pressure.) With modern equipment, tunnels large enough to drive a pickup truck through can be dug into hard rock at a rate of a hundred meters or more per day.[16] Most of the cost of an underground facility is in the entrance protection and the facility at the end of the tunnel, not the tunnel that connects to the outside. So digging deeper does not proportionately increase the cost and, at currently achievable rates, neutralizing the effect of any new nuclear bunker buster may require just a couple of shifts on a tunneling machine.

Second, the targeting problem is greater than it first appears because as the target gets deeper, its location can also become more uncertain while the accuracy needed to destroy it increases. Many deep underground bunkers are not constructed by digging down but by burrowing nearly horizontally into the side of a mountain. Once inside the mountain, the tunnel can make turns that are impossible to observe from the outside. Compensating for the resulting uncertainty requires either ever larger warheads or barrage attacks to cover the area where the tunnel *might* be. Of course, rather than attack the target itself, one could attack the entrance to the tunnel, or the power and communication lines, water, air supplies, and so forth, resulting in so-called "functional defeat." This is an especially attractive tactic if the target is not just a storage site but a communications or command center. However, if it is the entrance that is being attacked, one has to reevaluate nuclear weapons in comparison to conventional weapons that can also attack entrances.

An additional justification for nuclear attack on these targets is that the heat of a nuclear explosion can neutralize chemical and biological weapons. There are two reasons presented for the complete neutralization of the weapons. First, CBW retains its potency even if the shells, rockets, or bombs containing it are damaged beyond use; it may retain, therefore, some military utility. This may be true in theory but is implausible in practice. One of the reasons that CBW is such a proliferation danger is that it is easy to produce. No adversary would mop up VX or anthrax from the floor of a bombed out bunker and reload it into weapons; they would load new weapons from new production or from

bulk stockpiles. The second justification is that attack on CBW stores with conventional weapons would disperse the material without neutralizing it, causing unacceptable collateral damage to civilians. Nuclear weapons fail on two counts here. First, whether they would, indeed, destroy the CBW is uncertain.[17] Experiments with conventional explosives and surrogates could reveal much but the effectiveness of any given attack will depend sensitively on the details of the bunker design, the bioagent containers, even the weather, so the actual battlefield effectiveness will probably never be knowable. Second, even if the nuclear weapon were to destroy the CBW, reducing that danger, the radioactive fallout from the nuclear weapon would still remain a danger.

*Even if nuclear weapons eliminated collateral damage from CBW, that benefit only accrues when real targets are hit, while the damage from radioactive fallout would accrue with every nuclear weapon used, whether used against a real or supposed CBW target.*

Moreover, experience in Iraq shows that good intelligence on CBW is difficult to collect. In a real theater of war, many suspected targets would be attacked for every one that actually contained CBW. Even if nuclear weapons eliminated collateral damage from CBW, that benefit only accrues when real targets are hit, while the damage from radioactive fallout would accrue with every nuclear weapon used, whether used against a real or supposed CBW target. This last point requires emphasis because the mission is sometimes implicitly portrayed as one or two "surgical" strikes against central storage depots when in fact this mission would require dozens of attacks even in a fairly small theater of operations because the United States would have to strike not the sites where CBW is but where it is suspected to be. For example, in the recent Iraq war, hundreds of sites were suspected of hiding CBW. It turned out that none of them did. The radioactive release from the whole array of nuclear strikes has to be compared to the risk of CBW release from those sites that actually hold CBW.

**Mission 10: Damage limitation attacks against Russian/Chinese central systems**

Damage limitation by **defeating** enemy nuclear weapons was the mission of most of the later Cold War's central, intercontinental nuclear forces. This mission goal is what pushed the United States and the Soviet Union toward missiles with multiple, high yield, high accuracy warheads such as the Peacekeeper, the SS-18, and D5. Although officially the United States no longer targets Russian weapons, the U.S. arsenal today looks much as it would if a disarming first strike against Russia were still its dominant mission. To be most effective, this mission requires surprise first-strike attacks and probably would include attack on nuclear storage depots and other support centers.

Russia's nuclear forces and warning system have deteriorated dramatically since the end of the Cold War. There are times when the Russians have both no ballistic missile submarines at sea and their land-mobile missiles are in garrison. There are critical weaknesses in their strategic bomber force, which is now concentrated at just two bases, and major gaps in Russian early warning radar coverage; so a highly effective disarming first strike against Russia is conceivable. On the other hand, because the Russians have land mobile missiles, an effective first strike would have to be a surprise strike. For this mission to work well, the United States could not wait until days or weeks into a crisis but would have to fire early to catch the mobile missiles in their garrisons.

It may be that the utility of such a strike has not changed since the Cold War. Even if the effectiveness is now 99 percent rather than 90 percent because of decay of Russian nuclear weapons and warning systems, the stakes in any potential conflict are also much smaller. The smaller number of surviving warheads is offset by the smaller stakes so the United States remains just as thoroughly deterred. (The United States maintains substantial invulnerable forces at sea so Russia will remain deterred.)

This mission, more than any other, keeps the United States from breaking with the nuclear legacy of the Cold War, despite the completely transformed strategic nuclear equation. The weapons that the United States and Russia now have were developed and deployed at a time when the United States and the Soviet Union faced off in a global struggle. When both sides first deployed nu-

clear weapons, there was a fear of disarming first strikes, especially because nuclear weapons were carried aboard aircraft stationed at large vulnerable airfields. Later, missiles in silos created a period when weapons were safe from attack, both because neither side knew precisely where the missiles were and the missiles were not accurate enough to destroy protected silos. Beginning in the 1960s, new developments in satellitephotography allowed each side to locate enemy nuclear forces and improvements in guidance systems allowed each side to attack them.

*Almost all discussion of nuclear weapons today, especially arguments to justify retention of Cold War legacy weapons, ignore the history and context of why and how the weapons were developed and deployed in the first place.*

The urge to counter the threat of enemy nuclear weapons, ready to launch, was overwhelming and pursuing the means to allow attack of those weapons was probably inevitable. Yet, the "counterforce" mission was couched in terms of a new strategic imperative that accelerated the trend. In the middle of the Cold War, fears of Warsaw Pact conventional superiority in Europe were at a peak. Nuclear weapons were part of the foundation of deterring Soviet attack on Europe but the threat of escalating to nuclear weapons rang hollow if nuclear arsenals just checkmated each other. That is, if nuclear weapons just mutually deterred, they could not figure in the conventional equation where the West thought it needed help. To bring to bear the weight of central strategic nuclear systems, the United States had to be able to plausibly threaten to bring them into the conflict first, and the only plausible first target was Soviet central nuclear systems. The idea that the United States, not the Soviet Union, should be in a better position to decide whether to bring a war to the next level of violence was called "escalation dominance," a term used in pure nuclear calculations but also explicitly by Secretary of Defense Schlesinger in relation to forcing a favorable outcome in Europe.

None of these justifications is valid today, but the nuclear forces remain. Almost all discussion of nuclear weapons today, especially arguments to justify retention of Cold War legacy weapons, ignore the history and context of why

and how the weapons were developed and deployed in the first place. Specifically, nuclear weapons, even central intercontinental forces, were intended to weigh into the global conventional balance. The only reason this damage-limitation mission persists is that Russian nuclear forces exist and can destroy us. The conventional balance is now strongly in favor of the United States. The ideological engine that drove the competition has collapsed. Whatever nuclear symmetry existed during the Cold War is also gone. Because the United States always keeps large nuclear forces invulnerable at sea, the Russians have no hope of executing a disarming first strike against the United States, while the United States has at least a theoretical possibility of substantial success against Russia.

Russian nuclear forces do serve as a deterrent. Given its few thousand weapons, even a U.S. first strike of ninety-plus percent success leaves perhaps hundreds, and at least dozens, of multi-kiloton Russian weapons intact that could be launched in retaliation. The Russian approach of having thousands of nuclear weapons so a few survive poses a distinct problem to the United States because Russia's weapons could be launched first, in response to false indications of a U.S. attack. Some analysts consider accidental use of Russian nuclear weapons to be the single most likely, and certainly the most consequential, nuclear threat facing the country.[18] Such an attack by Russia is the only current threat to the United States that would end it as a society.

Unlike the missions discussed thus far, the size of the force needed for the damage limitation mission is tied directly to an adversary's nuclear arsenal size. As long as Russia depends on a large initial arsenal to guarantee that an adequate retaliatory force survives, it cannot reduce its nuclear forces. The United States cannot reduce its nuclear forces if it wants to keep a force large enough to target the large Russian force. The United States could simply abandon this mission, and give up on targeting Russian nuclear forces, but that will not make the threat from Russian weapons go away. The problem from the perspective of the United States is not U.S. weapons, of course, but Russian ones.

If the United States could arrange a deal, giving up on this mission in coordination with major Russian reductions, then the United States would reap profound advantages. To use round numbers for illustration, if the Russians had 2,000 warheads and the United States had a capability for a 90 percent successful first strike, then 200 would survive. After an attack by thousands of U.S.

weapons, these 200 would very likely be launched in retaliation. Of course, before a first strike, the Russians would have 2,000 weapons that they might launch, even by accident. Suppose the Russians had only 100 weapons that were utterly secure, perhaps because the United States had so configured its own arsenal to reduce its vulnerability (for example, eliminating fast flyers such as ballistic missiles). Then the United States would not be able to attack the 100 Russian weapons and reduce their number, but that number would never exceed 100. Moreover, the Russians would be less likely to adopt dangerous survival tactics, such as launch on warning or pre-delegation of launch authority, to insure survival of some missiles. Thus, both the likelihood and consequences of accidental Russian nuclear use would go down.

*The strategic counterforce mission sustains the most dangerous aspects of the world's nuclear forces.*

Mathematically, the second option is superior, but it is most likely politically impossible because it appears to limit U.S. options and power. (In fact, it accomplishes the same goal just as effectively but by accommodation, not by attack.) Nevertheless, this option indicates the direction towards which the United States and Russia may want to work, even if they never reach the final goal, because partial success brings partial benefits. Clearly, the risk of accidental launch is not proportional to arsenal size, halving the size does not halve the risk, but there is a connection: smaller forces, benefiting from more focused resources, will be better controlled and safer. Still, the United States might want to maintain a disarming first strike capability against emerging nuclear powers like Iran or North Korea; this is one case where the United States can have it both ways. Due to differences in weapons numbers and Russia's sheer size, the United States can have weapons of adequate numbers and ranges to attack Iran while not threatening Russian central nuclear systems. [19]

The Administration argues that Russian nuclear weapons are no more of a concern than other nuclear targets. But looking at the array of U.S. nuclear weapons and how they are deployed suggests strongly that counterforce attack on Russian nuclear forces is the shaping mission. For example, the need to attack targets in Iran and North Korea, or even the small long range arsenal of China, does not explain why hundreds of warheads must be invulnerably based at sea at all times. It does not explain the need for thousands of U.S. warheads,

nor their high readiness levels, nor the more thousands of warheads in ready reserve. The strategic counterforce mission sustains the most dangerous aspects of the world's nuclear forces.

**Mission 11: Retaliate for regional conventional attacks**

The U.S. could try to deter regional conventional attacks on its military forces or those of its allies, on the Korean peninsula for example, by threatening nuclear retaliation or by threatening to use nuclear weapons on the battlefield. Like any deterrence mission, this one has the problem that we can observe failures but successes remain unknown. The difference between this mission and the nuclear deterrence mission is that there are many failures to observe. The United States has been involved in several conventional wars since it developed nuclear weapons. The wars in Korea, Vietnam, and Iraq began in spite of a U.S. nuclear capability (although the Vietnam War began before the French acquired nuclear weapons.) There have been several smaller wars involving the United States. For most of these conflicts,-for example, in Panama, the United States initiated actual military operations, so they are not clear cases of failing to deter small countries. In some cases smaller countries, for example, in the former Yugoslavia, were the aggressors and challenged the United States despite its nuclear capability. The problem with this mission is the credibility of the response. Nations simply may not believe that the United States will easily cross the nuclear threshold, even in response to high levels of conventional conflict.

Deterring conventional attack against NATO by the Warsaw Pact was the dominant mission of tactical nuclear weapons deployed in Europe during Cold War. Then these weapons had a special role that no longer applies. In Europe, tactical nuclear weapons could be used to directly affect the ongoing battle. But they were also to serve as the first rung of an escalation ladder that led through intermediate range nuclear weapons that could reach the Soviet homeland from Europe, and further up the ladder to U.S. intercontinental forces. Because there was a sharp distinction between nuclear and non-nuclear weapons and, by design, a continuous progression from the smallest to the largest nuclear weapons, the battlefield nuclear weapons were a powerful deterrent. They were a deterrent in their own right and as a link to total nuclear war.

Today, however, if the plausibility of using battlefield nuclear weapons is

low, then the credibility of a link to central nuclear systems is vanishingly small.

Some nuclear advocates recognize the implausibility of nuclear threats in most contexts today and want to address that "problem" by developing ever smaller nuclear weapons, sometimes even called "micro-nukes" to distinguish them from "mini-nukes." Yields in the ranges of tens of tons of TNT equivalent are sometimes discussed. (A typical nuclear warhead today has a yield equivalent to tens to hundreds *of thousands* of tons of TNT.)

It seems illogical that building very small nuclear warheads, or "conventionalizing" nuclear warheads, should enhance deterrence by itself. Why should a nation be deterred by a nuclear weapon that is very much like a conventional weapon if it is not deterred by the equivalent conventional weapon? Lowering the nuclear threshold can enhance deterrence only if there is something distinctive about its being the *nuclear* threshold. The argument implicitly requires, therefore, maintaining the old Cold War link between the smaller and larger nuclear weapons. Otherwise, it is simply an expensive way to accomplish military missions that the United States can accomplish more easily with conventional weapons.

**Mission 12: Overawe potential rivals**

The **overawe** mission is distinct from the mission discussed above which sought to discourage nuclear developments by making enemy nuclear weapons vulnerable. The "overawe" mission seeks to maintain such an overwhelming nuclear force advantage that nascent nuclear nations are dissuaded from even trying to compete with the United States because the competition will seem hopeless. This mission is an answer to the "lower bar" argument used most often with respect to China. The problem is also sometimes cast in terms of gaining membership in the superpower club. If nuclear arsenals are a qualification for being considered a superpower, then the arsenal of the United States, the only universally recognized superpower, defines what a superpower's arsenal is. The U.S. interest is in keeping the barrier to entry into the club as high as possible. This mission blurs the distinction we try to maintain in this paper between missions and goals. In this case it is not clear what the specific mission for the nuclear weapons is, if the claim is that our just possessing them will impress potential rivals.

Specifically, if the United States maintains thousands of nuclear weapons, then China might be content with a minimal deterrent force less than one percent the size of the U.S. force (which it has now, counting only Chinese intercontinental weapons that can reach the United States) because a force comparable to America's is out of reach. If the United States were to reduce its forces to the low hundreds, however, then China could imagine matching that force and could be tempted to do so to accrue the benefits of being an equal nuclear partner or being considered a fellow superpower. The net result would be that reducing the number of U.S. weapons could *increase* the number of Chinese weapons facing the United States.[20]

What must one believe to believe the "lowering the bar" argument? As has been discussed elsewhere,[21] the first question is whether the Chinese are developing a nuclear arsenal based on some *absolute* goal, or whether they are going to build up forces *relative* to the U.S. or Russian or Indian arsenals. The Chinese have built a significant number of short- and intermediate-range nuclear weapons but few intercontinental weapons. It seems highly unlikely that they would set themselves a relative goal of, say, one percent of the U.S. arsenal. It is more likely they now have an absolute, and quite limited, goal or that they are on their way to some larger arsenal. Indeed, while their long-range systems are few, most analysts predict that the number of these systems will eventually grow (although this prediction has stood unfulfilled for years). Whatever the long-term Chinese goals regarding nuclear weapons, the Chinese seem to lack a Cold War-like urgency toward building up their long-range forces. The Chinese appear satisfied, at least for now, with some minimal deterrent force with respect to the United States.

If we are to accept the "lowered bar" argument, then we must not only believe that the Chinese are currently "absolutist" about their arsenal size (that is satisfied with some fixed number more or less independent of U.S. force size), but would remain so in the face of a long-term U.S. advantage and, moreover, that they would convert from absolutist to a "relativist" or competitive view if the U.S. arsenal fell below some threshold. Experience is too sparse to draw any firm conclusion, but those nations that set themselves limited goals (France, Britain, and Israel) kept their forces limited. But the Soviet Union began as competitive and always remained competitive.[22] This limited experience does

not show that it is inevitable that the Chinese would jump up for a "lower bar."

If China is absolutist, then it will build up to some level that it judges to be adequate and affordable fairly independently of what the United States does. In this case the United States could reduce its arsenal from 5,000 to 500 with no *increase* in the number of nuclear warheads threatening the United States. If China is relativist, whether it intends to maintain 10 percent or 100 percent of U.S. force size, reductions in the U.S. arsenal would directly *reduce* the threat the United States faces. Only if U.S. force reductions induce a change in the Chinese approach to force sizing is there a potential of a greater threat from China, and then only the potential, not the certainty. If the Chinese absolutist requirement was for 200 weapons, and their relativist requirement was for parity, then if U.S. reductions to 500 warheads induced the shift, it would lead to an increase in the number of Chinese weapons. But if their absolutist requirements were for 1,000 and their relativist requirements were for parity, or half the U.S. force, reductions by the United States to 500 could lead to fewer Chinese weapons even with a shift in approach to sizing.

As for Russia, we must assume it has inherited some of the competitive culture of the Soviet Union. It may, therefore, be readier to accept smaller forces if the U.S. forces go down. In fact, the overawe mission is tied closely to the damage-limitation mission against Russia. The primary reasons for the United States to maintain its large arsenal is to counter the Russian arsenal. There is a real, although impossible to quantify, threat from the large numbers of high-alert Russian weapons. In cooperation with Russia, this number could be reduced, yielding a real lessening of the threat to the United States. The question is whether this certain reduction in threat is outweighed by the theoretical possibility of an increase in the threat from China.

Rather than merely guess at the Chinese reaction, the United States could try to shape it, perhaps through explicit negotiation and agreement. The United States might arrange with the Chinese that they never go above a certain number if the United States agreed to go below some, no doubt higher, number. It would be advantageous to both sides and should be negotiable. It is unfortunate that arms control has so lost credibility that there are virtually no suggestions for negotiating nuclear weapon limits with the Chinese.

**Mission 13: Provide virtual power**

Some have argued that during the Cold War a muscular nuclear capability provided the ultimate security backstop, **assuring** the United States, giving it the confidence to remain engaged in the world.[23] This virtual power mission persists to some uncertain extent after the Cold War. The utility of this mission is difficult to evaluate because it rests on latent effect. The confidence the United States needed to decide to invade Iraq almost certainly did not include consideration of the U.S. arsenal of thousands of nuclear weapons, but the decision-makers were aware of it in the background. As tenuous as the connection between U.S. engagement and its nuclear arsenal may be, the connection is even weaker between U.S. engagement and the details of the size and makeup of the arsenal. Would the United States make any decision about global engagement differently if the arsenal were twice as large or only half as large? Working from this mission to concrete decisions about force structure, size, and deployment is almost impossible. It is almost as if virtual power were less a mission for nuclear weapons than a side effect of nuclear weapons. Whatever the Cold War requirements were to effect this mission, they are reduced now. The United States can bring to bear unsurpassed conventional superiority anywhere it wishes to be engaged, while the nuclear threat is substantially reduced. Thus, the need for *nuclear* reassurance is much smaller.

**Mission 14: Fight regional wars**

The NIPP report suggested that nuclear weapons might be used to **defeat** enemy conventional forces and rescue U.S. forces from a military debacle, such as a replay of Dunkirk or the Pusan Pocket. Others have suggested that they should be used if the use of nuclear weapons will save American lives. The implication is that this mission is not simply a few strikes at key targets but the general use of battlefield nuclear weapons, as was envisioned in Europe to stop a Warsaw Pact invasion. Nuclear weapons seem well suited to this mission because, under the right battlefield conditions, they can quickly destroy large numbers of enemy forces.

However, the relative advantage of nuclear weapons has essentially vanished since the widespread deployment of precision-guided munitions, which also can destroy large numbers of enemy forces quickly. Moreover, the enemy

tactical countermeasures needed to survive attack by U.S. precision munitions, such as dispersal and digging in, also reduce the effectiveness of nuclear attack. While continuing advances in conventional technology shrink the advantages of nuclear weapons, the costs remain high. In particular, a broadly nuclearized world where nuclear weapons are considered another type of battlefield weapon would work to neutralize the conventional advantage of the United States.

One can easily dismiss this mission as irrelevant, or at least superfluous, given the overwhelming conventional military advantage the United States has now and will keep for the foreseeable future. Still, the question remains: if, through some monumental tactical blunder, thousands of U.S. troops were threatened with defeat, should the United States use nuclear weapons to save them? The immediate loss of life has to be weighed against the consequences of breaking the long nuclear taboo. In fact, the taboo itself is the sum of calculations that the long-term consequences of using nuclear weapons overwhelm any short-term military gains. In terms of our goals, would the immediate benefits of **defeating** enemy forces outweigh setbacks when measured by the goals of **dissuasion** and future **deterrence**?

The first question is what the immediate benefits would be, not compared to doing nothing, but compared to the military effect the United States could bring to bear without nuclear weapons. With continuing developments in sensor-guided munitions, the relative advantage of nuclear weapons shrinks. In most battlefield environments, U.S. military commanders today would not ask for nuclear fires, even if they were freely available, because their effects are too indiscriminate compared to other weapons available. We must also keep in mind that the United States has to make a decision now to have this nuclear capability on standby in the rare event it might be needed. This would require maintaining tactical nuclear weapons plus all the associated long-term costs of security, storage, and special training and delivery systems. While defense budgets are large, they are finite, and these costs must displace expenditure on other, non-nuclear systems that can be routinely used. Most military decision makers would rather spend the money on additional conventional weapons to avoid the future Dunkirk in the first place.

The second question is what the long-term net benefit would be. It may be in the long-term interest of the United States to accept immediate battlefield

losses for the offsetting gain of maintaining the nuclear taboo. Use of nuclear weapons can work against the interests of a nation with conventional superiority. Thus, the choice is not between accepting losses and maintaining the nuclear taboo, but between accepting losses now instead of suffering even greater losses later.

**Mission 15: War Termination**

The only use of nuclear weapons in war was ours against Japan. It is widely credited with ending World War II in the Pacific. No one doubts that Japan's ultimate defeat was inevitable, but the two U.S. atomic bombs sent a shock through the Japanese military and government that forced them to face the undeniable and surrender. A similar situation could arise today.

For example, virtually all military analysts believe that the United States could defend the Straits of Taiwan against a Chinese attack, but it would be costly. Victory or defeat might not be in question but the United States might want to send a clear, shocking signal to the Chinese. Currently, almost any nuclear use would do that because of the clear distinction between nuclear and non-nuclear systems. Such use would broadcast that the United States considers the situation critical. This mission has as a goal an extension of **deterrence**, namely "compellance," forcing the enemy to stop doing something it is doing. This mission works only if nuclear weapons are regarded as weapons of last resort; thus nuclear weapons can be given this mission no more than once every couple of generations. Of course, nuclear weapons could be used more often, but then the shock effect of their use would be lost, and the mission would blend into conventional war-fighting.

The mission of war termination could contribute to **assurance**. Continuing our example, Taiwan might be tempted to develop a nuclear weapon but would not if it were confident that the United States would provide the needed shock on its behalf. Almost by definition, the war termination mission does not contribute to **deterrence** because the use of nuclear weapons does not come into play until deterrence has failed. One cannot even argue that the prospect of the use of nuclear weapons for war termination acts as a deterrent, because this mission (as opposed to a war-fighting mission) depends on the shock value, the unexpectedness of the nuclear use. By similar logic, this mission cannot contribute to **dissuasion**.

SECTION 3

# Conclusions

Of the fifteen missions evaluated here, only five demand nuclear weapons. The **overawe** mission is defined in terms of maintaining a huge nuclear superiority. Similarly, providing **virtual power** is defined in terms of the intangible benefits of not simply overwhelming military power in general, but of nuclear weapons in particular. These two missions, which by definition require nuclear weapons, are the most difficult to pin down. This makes both missions difficult to defend; it also makes arguments in favor of both difficult to refute. We believe that arguments for the **overawe** mission are implausible but we cannot prove they are flatly wrong. The **war termination** mission depends on the shock of specifically nuclear use.

Two other missions require nuclear weapons in practice: **retaliation for nuclear attack** and **disarming first strikes** against Russia, and perhaps China. If attacked with nuclear weapons, the United States could, in principle, retaliate with conventional weapons. Indeed, that may be the preferred course against small countries. In fact, if North Korea used a nuclear weapon against the United States, "retaliation" is not the word for what would follow. The North Korean government would be doomed whether the United States used nuclear weapons or not. One can imagine that afterwards, because the United States would inevitably occupy North Korea, it might forego responding with nuclear weapons. But if hit with a nuclear attack by a large country, Russia or China, the United States would almost certainly retaliate with nuclear weapons, to inflict pain and counter any remaining threat. For this mission, nuclear weapons are appropriate because the conventional military alternative of invading and occupying such large nations as China and Russia is impractical.

Maintaining the ability to execute **a disarming surprise first strike** against Russia is also an essentially nuclear mission. But this mission makes sense only if it comes close to total success. Since the Russians would most likely launch their nuclear missiles rather than watch them be destroyed, time is of the essence. The U.S. strike would have to destroy everything in one blow. At least some Russian nuclear weapons are hardened enough to require multiple attacks with conventional weapons. The need for post-attack evaluation and re-attack does not allow time for conventional attack. Although the United States claims that a **disarming first strike** is not an explicit mission of U.S. nuclear forces, the nature of the arsenal argues otherwise. Also this mission is suggested by the Administration's "defeat" goal.

Of the necessarily nuclear missions, the need to maintain a **disarming first strike** seems to drive the size, structure, and deployment of U.S. nuclear forces. This is also the mission that most tightly binds U.S. force requirements to the size of the Russian arsenal.

If, *and only if*, the United States and Russia can find some way to forgo this mission, most likely through agreed reductions and changes in the characteristics of their delivery systems, are further major reductions in the world's nuclear arsenals possible.

All of the remaining missions are potential nuclear missions but conventional weapons can also fulfill each. We are at the end of a long process of having conventional weapons displace nuclear weapons. We no longer have Genie air-to-air nuclear rockets or Davy Crocket nuclear rockets launched from jeeps. There is no reason to believe this trend away from nuclear weapons has ended. Further developments in sensors, explosives, and computer guidance will continue to make conventional alternatives more appealing.

What appears to be a niche target for nuclear weapons, **deep bunker penetration**, is most likely ephemeral. The United States and other advanced nations now have precision munitions that can attack surface targets, so countries have dug underground. The United States is not expected to be profligate with tactical nuclear weapons, so in many cases countries have dug deep enough to be safe from existing conventional weapons but not deep enough to be safe from nuclear weapons. As soon as the United States begins to deploy nuclear "bunker

busters," however, the digging could resume and the digging could be done long before the new nuclear weapons could be deployed. Indeed, leaving targets in that narrow zone beyond conventional attack but within nuclear attack would positively invite nuclear attack.

When evaluating the missions that can be fulfilled with either nuclear or conventional weapons we should compare across types. Comparing a five kiloton earth penetrating weapon to a one megaton surface-burst weapon misses the point if a one ton conventional weapon can get the job done. Nuclear weapons can fulfill almost every mission suggested here. That is not in question. The question is whether they are the weapons of choice. Compared to conventional alternatives, the advantages of nuclear weapons range from none to small. Their disadvantages extend far beyond the battlefield of the day. These disadvantages include proliferation effects around the world and loss of moral leadership. The United States benefits from a global conventional military advantage. Anything that moves the world toward facile nuclear use erodes that conventional advantage and works against the interests of the United States.

*If the Russian threat is taken as a given, then nuclear advocates can ignore it while figuring ways to leverage a slight tactical or strategic advantage elsewhere. If the Russian threat is a variable, then the United States should not let the risk from Russian weapons persist a day longer than necessary.*

If the preceding mission analysis is correct, then the implications for decisions before the nation today are straightforward. One problem with discussion about nuclear weapons is that the overwhelmingly largest threat, that from Russia, has been with us so long it has become part of the landscape, a constant, not a potential variable. Russian nuclear weapons, even if launched by accident, are the only threat the United States faces that could destroy it utterly. If the Russian threat is taken as a given, then nuclear advocates can ignore it while figuring ways to leverage a slight tactical or strategic advantage elsewhere. If the Russian threat is a variable, then the United States should not let the risk from Russian weapons persist a day longer than necessary. In particular, vague benefits from

the **virtual power** and **overawe** missions should not outweigh the very real, immediate, ongoing risks presented by Russian nuclear weapons.

This analysis argues that a disarming first strike against Russian nuclear forces is the current mission that underpins the U.S. force structure, determining its size, performance, readiness, and deployment. We must not confuse a disarming first strike with deterrence, as some do. After the Cold War, the deterrence mission is comparatively easy while the first strike mission against Russia remains difficult. This mission, moreover, encourages the Russians toward dangerous behavior, for example, maintaining large forces, quick force dispersal, launch authority delegation, or launch on warning.

Ironically, maintaining our ability to destroy most Russian nuclear forces *increases* the nuclear threat to the United States. Outside of the Cold War context, there is little advantage but great cost to pursuing this mission. This analysis argues that the United States could give up on this mission, in cooperation with Russia, to reduce substantially its own nuclear risk. Deterrent forces much smaller than first strike forces would negate a smaller Russian nuclear force and still be large enough for some counterforce missions against smaller rogue countries. This approach may require engagement with the Chinese on nuclear planning. Also, clearly, this approach requires a radical departure from the current U.S. course. But only by abandoning this one mission will the United States and Russia be able to break through the legacy of the Cold War and further reduce their nuclear arsenals from thousands to hundreds.

The remaining nuclear missions are either warfighting missions (for example, attacking CBW in a theater of operations) or they are dissuasion missions that require that the United States has the capability and plausible intent to use nuclear weapons in theater. Most of these missions depend on the ability to find small, easily hidden, potentially mobile weapons, such as biological weapons that could be carried in a pickup truck. The technical feasibility of finding the targets, including buried targets, being able to attack them, being able to defeat the biological agent, and the associated collateral effects are unknown and, in a real battlefield, probably unknowable. The cost to the United States of nuclearizing conflicts is very real, if impossible to quantify. The United States should not, therefore, develop earth penetrators or new small tactical nuclear weapons. The worst possible outcome will be if the United States, as a hedge, continues to explore nuclear possibilities and these programs are interpreted as

eventual deployment plans, further weakening non-proliferation norms. The United States could, thereby, turn a hedge against a hypothetical threat into a real threat.

## APPENDIX

### Nuclear "Usability" and Likelihood of Use

The proposals for several of the missions discussed here concede that while nuclear weapons might in theory be useful, today's nuclear weapons are so large and destructive that U.S. threats to use them are not credible. Thus, some mission proposals are coupled to suggestions for a new post-Cold War generation of smaller, more "usable," nuclear weapons. Since the mission of every nuclear weapon, we are told, is deterrence, by making nuclear weapons more usable we make them better deterrents, hence less likely to be used. We call this the "more is less" argument.

The "more is less" argument depends on looking at nuclear use as at least a two step process: first, a crisis of such seriousness develops that nuclear use is considered, and second, the crisis escalates to actual nuclear use. This is an extremely simplified model of the many steps (the signaling, and so forth) that would be involved in going from peacetime to even limited nuclear war but even so, it allows a limited examination of how increasing usability can reduce the probability of nuclear use. In the simple two step model, the probability of nuclear use, $P_n$, is the product of the probabilities of each step, that is, the probability of getting into a crisis, $P_c$, times the probability, $P_e$, of the crisis escalating to nuclear use. That is,

$$P_n = P_c \cdot P_e \qquad \text{Eq. A1.}$$

What the enhanced deterrent argument boils down to (if it is to make any sense at all) is that by making nuclear weapons more "usable" we should increase the probability of escalation, $P_e$, because doing so makes our adversaries even more wary. Thus, the probability, $P_c$, of entering a crisis in the first place is reduced more than enough to compensate, so the overall nuclear use probability, $P_n$, is actually lower. This is shown graphically in Fig A1.


**Fig A1**

An important point is that there can be two $P_e$s. Deterrence occurs before any resulting retaliation. The notional aggressor cannot know, therefore, the actual probability of escalation, $P_e$. He bases his decisions on his perception of what these probabilities are. So the probability of getting into a crisis, $P_c$, depends on perception of $P_e$, while the likelihood of nuclear escalation depends on the actual $P_e$. The calculations assume that the two values are the same; we will discuss later the effects when they are different. The two $P_e$s suggest one resolution to the "more is less" argument, namely that the United States can work very hard to increase the perception of the usability of its own nuclear warheads but, in the end, it maintains control over the decisions about their use and can simply decide not to use them, thus not increasing the actual probability of their use.

What must one believe to believe that increasing the "usability" of nuclear weapons reduces the likelihood of their use? Basically, one has to believe that, as the usability goes up, the probability of getting into a crisis has to go down more than the probability of escalation rises.

First we need to define "usability." For this argument to work "usability" must translate into likelihood of use: more "usable" is more likely to be used, or

at the very least, a strong belief on the part of adversaries that this is true. Since we know of no other competing definition, we will, for the purposes of this appendix, define "usability" as equivalent to the probability that a weapon will be used in any crisis, however defined. Thus, "usability" is expressed in terms of a probability, for example, a weapon that has a 50 percent chance of being used will have a "usability" of 50 percent. Some who advocate increased "usability" to reduce the probability of use will object to this simplified definition. They are invited to come up with some other definition that makes their argument sensible.

What we really want is not Eq 1, but how the probability of nuclear use changes as we change usability. Taking the derivative of either side of Eq. A1 with respect to the usability, u, and remember that, by definition, $d P_e/du=1$, we derive the following inequality:

$$-dP_c/du > P_c/P_e \qquad \text{Eq. A2.}$$

The left hand side is just the derivative, that is, the slope of the line in Fig. A1 (the negative sign just indicates that it is sloping down to the right rather than up). The equation tells us that, if and only if the magnitude of the slope of the line is greater than the ratio of $P_c$ to $P_e$ will an increase in "usability" actually decrease the likelihood of use. Of course, no one knows the values of $P_c$ and $P_e$ with any great accuracy but we can make reasonable guesses at the *range* of values they might have and see what insights that gives us.

First we consider the numerical value of $P_c$. It is the probability that a crisis occurs, one in which the United States at least considers the use of nuclear weapons. Of course, there might be much ambiguity about the definition of a "crisis" in general and what it means to "consider" nuclear use. But for this discussion on deterrence, the definitions are easier to specify. Using, for example, the threat of nuclear retaliation to deter CBW use, a "crisis" is defined as use of CBW because we want to use nuclear weapons to reduce the likelihood of CBW use. The following discussion is general applying to any crisis. The mathematics is the same but, in general, if the mission is to deter X by threatening retaliation, then the definition of "crisis" is the occurrence of X. Over the course of the 40 or so years of the Cold War, the "crises" include at least the two major wars, Korea and Vietnam, and the Cuban Missile Crisis, which has even incor-

porated the word into its label. If one casts the net widely, one might include the Berlin blockade, the 1973 Arab-Israel war and others. Thus during the Cold War, depending on definitions, there were three to six "crises." So the probability of a crisis, expressed in terms of "number of crises per year" would be between 0.08 and 0.16. We do not have as long a post-Cold War history, but we have fought at least two wars with one power, Iraq, that was assumed to have, or could have had, CBW or nuclear weapons. So the post-Cold War frequency so far seems to be in the same range.

The world is lucky that it does not have any data since 1945 on the value of $P_e$, the probability that a crisis will escalate to nuclear use. Some might say that the World War II nuclear bombings are unique to that context and give us no insight into the likelihood of contemporary nuclear use. Since then we have had no nuclear weapons used in conflict. So can we know anything at all about $P_e$? Yes, because *not* observing something allows some estimate of the *upper* limit on how likely it is to occur. For example, if we define, say, ten events as being crises, and none of them has led to nuclear use, we can say there is an even chance that the probability of escalation is no greater than about 6%. (That is, if there is a six percent chance of seeing an event, then there is a 94% chance we will not see the effect in one test and after ten tests there is a 50 percent chance we will have not seen a single event. If we have only five events meet our definition of "crisis," then absence of escalation implies that it is probably no greater than 13% likely per event.) Of course, the probability could be zero. Not observing something gives us no idea about the lower limit of its likelihood. So depending on how broadly or narrowly we define "crisis," the escalation likelihood ranges from 0 to six percent or from 0 to 13 percent.

Thus, we see that we do not know precise values of $P_c$ and $P_e$ but we can make estimates of their ranges. Even though the estimates cover a broad range of values, they are not guesses drawn from the air but roughly based on experience. What do these values tell us? If we take the extreme combinations, that is combine the largest numerator and smallest denominator and vice versa, the range of the ratio in the above equation is between 0.6 and 2.7, with the lower number being the most optimistic. So taking the best case of the 0.6 value, if the usability, defined here as the likelihood of using a nuclear weapon in a crisis, is increased by 10 percent then the overall likelihood of nuclear use will go down if the likelihood of getting into a crisis in the first place is reduced by 6%. If the

value of the ratio is 2.7, then a 10 percent increase in usability would require a 27% reduction in likelihood of getting into a crisis to make the overall likelihood of nuclear use go down. It is important to note that the key quantity on the left side of equation Eq. A2 is not the actual likelihood, but the *change* in the likelihood of a crisis as the nuclear usability changes.

Almost everyone will agree that any nation that attacks the United States with nuclear weapons will be attacked in turn with nuclear weapons, regardless of their "usability." That is to say, the likelihood of use is insensitive to nuclear usability and the left side of the equation is small and the conditions to make the "more is less" argument valid are virtually impossible to meet. At the opposite extreme, a minor incident is not going to bring on a nuclear retaliation regardless of the usability of nuclear weapons. Only in some intermediate cases might the use of nuclear weapons be weighed among other options and the usability of the weapons figures into the calculation.

The historical record barely allows a rough estimate of the likelihood of crises. It certainly does not allow estimates of the change in likelihood due to changes in perceptions of nuclear usability. For that, we must fall back on judgment. Most students of crisis would probably consider the reduction in crisis probability required by the equation is larger than that found in the real world. In sum, the conditions needed to reduce overall probability of nuclear use will be difficult to meet. This might not be a concern since the mission we are considering is retaliation. Our goal in this instance is deterrence of, for example, CBW attack. Our simple model is merely designed to examine the assertion that more usable nuclear weapons may be less likely to be used. We find that the assertion is most likely invalid but that does not mean that the nuclear mission has failed to achieve its goal. Perhaps nuclear use will, in fact, be more likely, and occasional use of nuclear weapons will, indeed, deter CBW attack. So CBW use will be less likely and nuclear use more likely. This is exactly the result that common sense leads us to instead of the seemingly paradoxical "less is more" argument.

We constructed this simple two-step model of escalation to make sense of the argument that more usable weapons are less likely to be used. But how would the results change as we added more realistic complexity to the model? First, note that the "more is less" argument is stronger when the ratio of $P_c$ and

$P_e$ is smaller. That is, when $P_c$ is smaller and $P_e$ is larger. We have to keep in mind that the range for $P_e$ is not 0.06 to 0.13, that is the range of the upper ranges. We have not observed escalation to nuclear use (setting aside 1945) so we do not know the lower bound. It could be very small indeed, making the ratio large, making the "more is less" conditions even more difficult to meet.

The simple model assumes that the likelihood of getting into a crisis depends on the robustness of our nuclear deterrent. In fact, crises are commonly (some argue most often) the result of mistake rather than calculation. Some crises are the result of blunders. Playing chicken with U.S. reconnaissance aircraft flying along the coast of China was intentional, but crashing into one almost certainly was not. Bombing Belgrade was intentional but bombing the Chinese embassy was not. These crises occurred independently of formidable nuclear deterrent forces. Other crises come about from miscalculation. George and Smoke, in their study of Cold War deterrence, hypothesize that nations are most likely to escalate crises when they believe they can keep control of the situation and step back if the escalation does not work to force a desired outcome. Failures of deterrence occur when the expectations of escalation control prove false. The North Koreans, for example, seem to engineer crises to achieve political ends and it is easy to imagine how any one of these could get out of control. To the extent that crises flare up instead of being the result of deliberate calculation or are due to miscalculation, increasing the usability of nuclear weapons simply increases the likelihood of nuclear use.

The model also assumes that the deterrent value of nuclear weapons depends only on the likelihood of their use. To the extent that a potential attacker is weighing risks in a deterrence calculation before deciding whether to attack, he will consider both likelihood and consequences of a U.S. retaliation. But building nuclear weapons that are less destructive to make them more plausibly useable also makes them less frightening. Thus, a potential attacker might accept that nuclear retaliation is more likely but the consequences of use are also less severe, so he could be less, not more, deterred overall by smaller nuclear weapons. It is difficult to judge how large this effect is but, however great, it will tend to shift the calculus above toward a greater likelihood of nuclear use.

## ENDNOTES

[1] Moreover, current U.S. plans are for high-yield earth penetrators. See Jonathan Medalia, *Nuclear Earth Penetrator Weapons*, Congressional Research Service, 27 January 2003. At shallow burial depths there will be only small differences in fallout produced.

[2] "U.S.-Soviet/Russian Nuclear Arms Control," *Arms Control Today*, June 2002.

[3] Linton F. Brooks, "U.S. Nuclear Weapons Policies and Programs", Presented to the Carnegie International Nonproliferation Conference, June 21, 2004. http://www.ceip.org/files/projects/npp/resources/2004conference/speeches/brooks.doc

[4] David Mosher "The Hunt for Small Potatoes: Savings in Nuclear Deterrence Forces," in *Holding the Line: U.S. Defense Alternatives for the Early 21st Century* (Cambridge: MIT Press; 2001), Cindy Williams, ed.

[5] See Statement of Administration Policy, H.R. 1588-National Defense Authorization Act for Fiscal Year 2004, Executive Office of the President, Office of Management and Budget, May 22, 2003, p. 2, ("Low-Yield Nuclear Weapons"), http://www.whitehouse.gov/omb/legislative/sap/108-1/hr1588sap-h.pdf

[6] Linton Brooks, "FY 2004 National Defense Authorization Act", Memorandum to Pete Nanos, Director, Los Alamos National Laboratory; Michael Anastasio, Director, Lawrence Livermore National Laboratory; C Paul Robinson, President, Sandia National Laboratory, December 5, 2003. http://www.ananuclear.org/Brooks%20Memo.pdf

[7] Important papers dealing more broadly with nuclear missions include: Keith Payne, *Rationale and Requirements for U.S. Nuclear Forces and Arms Control*, Vol. 1, Executive Report, (Fairfax, Virginia: National Institute for Public Policy, 2001); U.S. House of Representatives, House Policy Committee, Subcommittee on National Security and Foreign Affairs, *Differentiation and Defense: An Agenda for the Nuclear Weapons Program*, February 2003; C. Paul Robinson, *Pursuing a New Nuclear Weapons Policy for the 21st Century*, Sandia National Laboratories, March 22, 2001 (available at http://www.sandia.gov/media/whitepa-

per/2001-04-Robinson.htm); Stephen Younger, *Nuclear Weapons in the Twenty-First Century*, Los Alamos National Laboratory, LAUR-00-2850, June 27, 2000 (available at www.fas.org/nuke/guide/usa/doctrine/doe/younger.htm); excerpts of the leaked 31 December 2001 Nuclear Posture Review are available at www.globalsecurity.org/wmd/library/policy/dod/npr.htm; Michele Flournoy and Clark Murdock, *Revitalizing the U.S. Nuclear Deterrent*, (Washington DC: Center for Strategic and International Studies) July 2002; Glenn Buchan, David Matonick, Calvin Shipbaugh, and Richard Mesic, *Future Roles of U.S. Nuclear Forces: Implications for U.S. Strategy*, (Santa Monica: RAND, 2003), (this report was written in 2000 but held up in security review until its 2003 publication date); and Robert Joseph and Ronald Lehman, *U.S. Nuclear Policy in the 21st Century: A Fresh Look at National Stategy and Requirements*, (Center for Counterproliferation Research-National Defense University and Center for Global Security Research-Lawrence Livermore Laboratory, July 1998).

[8]In the article in which he used the term "massive retaliation, Dulles wrote, "The heart of the problem is how to deter attack. This, we believe, requires that a potential aggressor be left in no doubt that he would be certain to suffer damage *outweighing any possible gains from aggression*." (Emphasis added.) John Foster Dulles, "Policy for Security and Peace," *Foreign Affairs*, 32(3), 1954.

[9] As Secretary Rumsfeld put it in his 1978 Report to Congress, "We believe that a substantial number of military forces and critical industries in the Soviet Union should be directly targeted, and that an important objective of the assured retaliation mission should be to retard significantly the ability of the USSR to recover from a nuclear exchange and regain the status of a 20th-century military and industrial power more rapidly than the United States." Donald Rumsfeld, Report of Secretary of Defense Donald H. Rumsfeld to the Congress on the FY 1978 Budget, FY1979 Authorization Request and FY 1978-1982 Defense Programs, (Washington, DC: U.S. Government Printing Office, 17 January 1977), p. 68.

[10] John J. Mearsheimer and Stephen M. Walt, "An Unnecessary War," *Foreign Policy*, January/February 2003.

[11] United States Congress, Office of Technology Assessment, *Proliferation of Weapons of Mass Destruction: Assessing the Risks*, OTA-ISC-559, August 1993.

See, in particular, graphics on p. 53 and accompanying text. Available online at:
http://www.wws.princeton.edu/cgibin/byteserv.prl/~ota/disk1/1993/9341/9341.PDF

[12] Michael Levi, *Fire in the Hole: Nuclear and Non-nuclear Options for Counter-Proliferation*, Carnegie Endowment Working Paper Number 31, November 2002

[13] Joseph Cirincione, *Deadly Arsenals: Tracking Weapons of Mass Destruction*, (Washington, DC: Carnegie Endowment for International Peace; 2002), p 52 and p 67.

[14] Younger in *Nuclear Weapons* above mostly clearly argues that the United States needs weapons to hold at risk any and all potential targets an enemy may have.

[15] Robert Nelson, "Low-Yield Earth-Penetrating Nuclear Weapons, " *Science and Global Security*, vol. 10, pp. 1-20, 2002; see graph on p. 4.

[16] For a Colorado water project, a commercial firm dug a tunnel just short of 10,000 feet long. The 10-foot diameter tunnel was extended 219 feet through hard rock in one record-breaking 12-hour shift. From the online version of Tunneling Business Magazine, July 2001 (link is no longer active).

[17] Michael May and Zachary Haldman, *Effectiveness of Nuclear Weapons against Buried Biological Agents*, The Center for International Security and Cooperation Report, Stanford University, May 2003.

[18] Bruce Blair, et. al., *Toward True Security: A U.S. Nuclear Posture for the Next Decade*, published jointly by the Federation of American Scientists, the Natural Resources Defense Council, and the Union of Concerned Scientists, June 2001, available at
http://www.ucsusa.org/global_security/nuclear_weapons/page.cfm?pageID=624 .

[19] The recent Defense Science Board Report on future nuclear weapons makes a similar point. The report distinguishes sharply between possible nuclear enemies that are deterrable and those that are not. Deterring deterrable states,

specifically Russia and China, is much easier in today's security environment than it was during the Cold War, and deterring undeterrable states and terrorists is, of course, by definition impossible. Against the latter we must strive for the best counterforce capability we can manage. Against deterrable great powers, we require a more nuanced ability to bring the conflict to an end as quickly as possible. See *Report of the Defense Science Board Task Force on Future Strategic Strike Forces*, Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics, Washington, D.C. 20301-3140, William Schneider, Chair. In particular, see Chapter 2, "Concepts of Opperations."

[20] This idea was put forth very clearly by Congressman Thornberry, "The lower we make the threshold for becoming a world power, the more tempting it becomes. There may not be an appreciable difference whether the U.S. has 7,000 or 4,000 weapons. Even 2,500 weapons may seem unreachable for an emerging nuclear power with a few dozen weapons on hand. But matching a U.S. stockpile of 500 or 1000 weapons may seem much closer and much more achievable, both practically and psychologically. We do not want to lower the bar so much that others are encouraged to try to jump up and reach it particularly those who see nuclear weapons as a shortcut to global influence." Congressman William M. "Mac" Thornberry (R, Texas), *The Washington Times*, 15 June 2001. Note that he defines being a "world power" in terms of a nuclear power.

[21] Ivan Oelrich, *Sizing Post-Cold War Nuclear Forces*, Institute for Defense Analyses, Paper P-3650, Log H 01-001765, October 2001, pp. 42-44.

[22]The Soviets kept increasing their warhead count as long as there was a Soviet Union. "NRDC Nuclear Notebook, Global Nuclear Stockpiles, 1945-2000," Bulletin of the Atomic Scientists, Vol 56, No. 2 (Mar/Apr 2000) , p 79.

[23] Harold Brown wrote, "…behavior in periods of tension can be (and in my judgment is) influenced by the nature of the strategic capabilities and the relative balance of strategic forces, even if the use of those strategic forces is very unlikely. Real consequences have followed the shift since the late 1960s away from a perceived U.S. strategic superiority. This U.S advantage would have been of only marginal value in a thermonuclear war and was of limited political value, but its loss has had a significant effect on relations between the United States and its allies and on the attitudes of people in other countries toward the

United States." Harold Brown, *Thinking about National Security: Defense and Foreign Policy in a Dangerous World* (Boulder: Westview Press, 1983), p 51.

[24] Alexander L. George and Richard Smoke, *Deterrence in American Foreign Policy: Theory and Practice* (New York: Columbia University Press, 1974).

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