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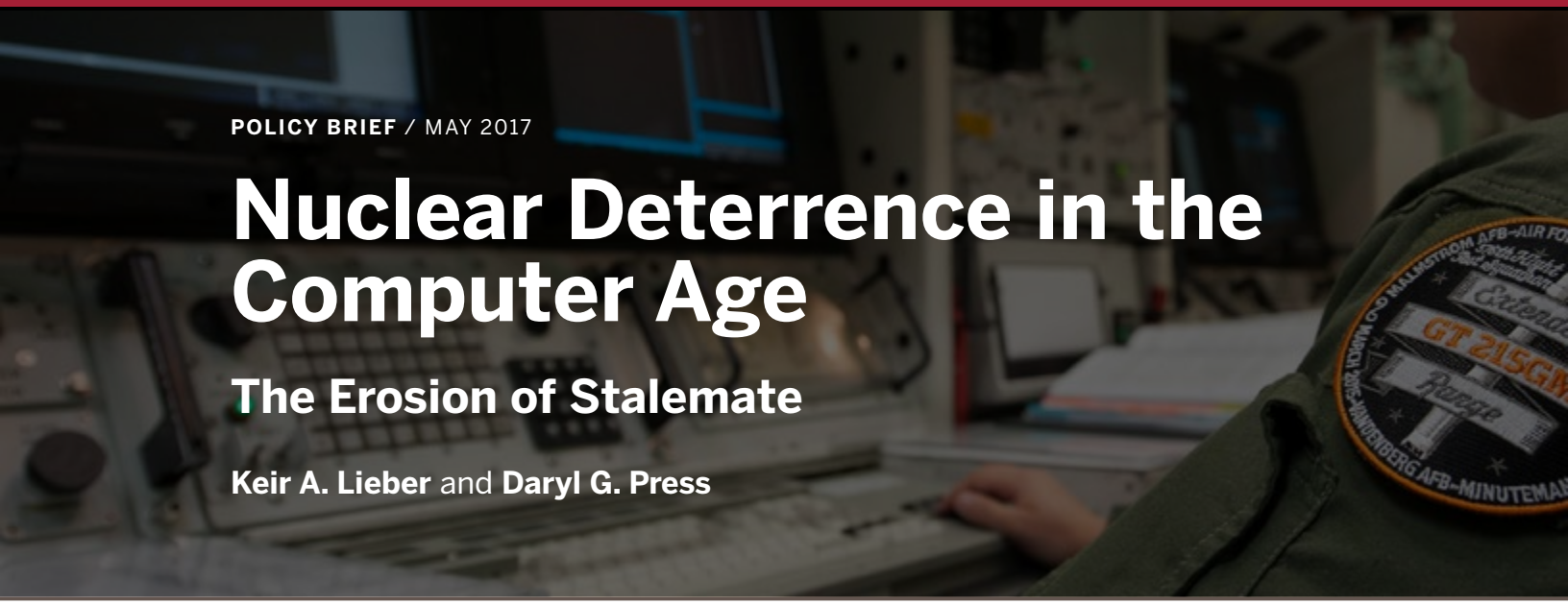

POLICY BRIEF / MAY 2017

Nuclear Deterrence in the Computer Age

The Erosion of Stalemate

Keir A. Lieber and **Daryl G. Press**

This policy brief is based on "The New Era of Counterforce: Technological Change and the Future of Nuclear Deterrence," which appears in the spring 2017 issue of *International Security*.

Bottom Lines

Eroding Foundation of Nuclear Deterrence. Technological advances are increasing the vulnerability of nuclear arsenals. In particular, leaps in weapons accuracy and the revolution in remote sensing are creating new opportunities for successful disarming strikes.

Illogic of Nuclear Arms Control. Nuclear arms reductions are sensible when they decrease first-strike incentives, save money, and soothe strained relations among adversaries. The combination of shrinking nuclear arsenals and growing counterforce capabilities, however, is dangerous. Further nuclear arms reductions could be destabilizing.

Double-Edged Sword of Counterforce. U.S. counterforce capabilities will increasingly threaten the arsenals of potential adversaries, possibly triggering counterproductive arms races. Yet, those same capabilities could also be invaluable: deterring the outbreak of conflict; preventing adversary escalation during a conventional war; and protecting U.S. forces, allies, and the U.S. homeland if war occurs.

1st Lt. Kimberly Erskine, Missile Combat Crew commander at Malmstrom Air Force Base, practices procedures March 19, 2015, at Vandenberg AFB, California, in preparation for the launch of an unarmed Minuteman III intercontinental ballistic missile. (USAF / Michael Peterson)

Nuclear deterrence rests on the survivability of nuclear arsenals—that is, their ability to withstand an enemy's first strike and retaliate. For much of the nuclear age, arsenal survivability (and hence deterrence) seemed straightforward. "Counterforce" disarming attacks—those aimed at eliminating an enemy's retaliatory forces—were nearly impossible because potential victims could easily hide and protect their weapons. Today, however, leaps in weapons accuracy and the revolution in remote sensing are eroding states' ability to secure their arsenals. Specifically, two key approaches that countries have relied upon to ensure arsenal survivability, hardening and concealment, are being negated by pinpoint accuracy and improved sensors. The computer revolution has also spawned dramatic advances in data processing, communication, missile defense, artificial intelligence, anti-submarine warfare, and cyber operations—each of which compounds the impact of improved accuracy and sensing. This study uses geospatial analysis and a set of unclassified models to illustrate the growing effectiveness of counterforce capabilities. The implications for nuclear policy are far reaching: the new era of counterforce will likely undermine deterrence stability, undercut the wisdom of future nuclear arms reductions, and compel U.S. leaders to balance the risks and opportunities of honing U.S. counterforce capabilities.

Eroding Foundation of Nuclear Deterrence

Nuclear weapons are the ultimate instruments of deterrence. There is no conceivable benefit from invading or attacking a rival if doing so would trigger nuclear retaliation. As long as nuclear arsenals are secure, and hence could survive an adversary's attack and still retaliate, nuclear weapons should be a tremendous source of security for those who possess them. For this reason, military planners have worked hard to protect their countries' nuclear forces from attack. Specifically, they have relied on three core strategies: hardening (e.g., storing nuclear forces in reinforced silos and bunkers), concealment (moving and hiding those forces), and redundancy (e.g., bolstering survivability by maintaining diverse and large forces).

Major technological trends are undermining these strategies of survivability. Leaps in weapons accuracy have diminished the value of hardening, while breakthroughs in remote sensing threaten nuclear forces that depend on concealment. The significant reduction of nuclear arsenals since the end of the Cold War weakens the third strategy of survivability: redundancy. Deploying survivable nuclear forces in this environment is not impossible, but the challenge of protecting those forces is growing.

For most of the Cold War, long-range ballistic missiles were not accurate enough to destroy hardened target sets, such as fields of missile silos. For example, in 1985 a warhead from a U.S. submarine-launched ballistic missile (SLBM) had approximately a 9 percent chance of destroying a hardened silo. This meant that although SLBMs could destroy "soft" targets (e.g., cities), they could not destroy enough hardened sites to eliminate an adversary's retaliatory force. Today, because of vast improvements in submarine geolocation and missile guidance systems, a single submarine-launched warhead would have approximately a 90 percent chance of destroying a hardened silo. As a result, plausible strikes could eliminate even large enemy arsenals (e.g., 200 hardened missile silos). In fact, accuracy improvements now permit attackers in some cases to use low-yield nuclear weapons (or even conventional weapons) to destroy counterforce targets, greatly reducing collateral damage. The effectiveness

of a particular strike would depend on many technical and strategic factors, but the underlying trend is stark: hardened nuclear forces have grown vulnerable.

While advances in accuracy are undermining the value of hardening, leaps in remote sensing are chipping away at the other main approach to achieving survivability: concealment. Finding concealed forces, particularly mobile ones, remains a major challenge. Trends in technology, however, are eroding the security that mobility once provided. For example, in the 1991 Persian Gulf War, the U.S.-led coalition had enormous difficulty finding mobile Iraqi missiles. Today, the United States can approach the same challenge with better and more diverse sensing platforms (including improved radar satellites, drones, and autonomous ground sensors); the means to collect a widening array of signals from across the electromagnetic spectrum (and do so persistently); and an improved ability to rapidly process and transmit data to commanders. In the ongoing competition between "hiders" and "seekers," waged by ballistic missile submarines, mobile land-based missiles, and the forces that try to track them, the hider's job is growing more difficult than ever before. Nuclear survivability through concealment can no longer be assumed.

Illogic of Nuclear Arms Control

The growing threat to nuclear arsenals raises major policy questions about the wisdom of reducing those arsenals. Historically, states have pursued arms control to increase strategic stability, prevent attacks, and soothe relations with adversaries through mutual cuts. Yet as the effectiveness of nonnuclear means of counterforce grows—for example, through improved conventional weapons, missile defenses, anti-submarine warfare systems, and cyber operations—nuclear arms reductions may increase the vulnerability of various countries' forces to disarming strikes. The problem is stark: arms control agreements that only cut nuclear weapons reduce the number of targets that must be destroyed in a disarming strike; all the while, the nonnuclear forces that aim at those targets grow in number and capability.

Arms control advocates may seek to solve this conundrum by advocating small arsenals deployed on inherently secure delivery systems, such as submarines or mobile missiles. To be sure, it is wise to deploy nuclear forces on delivery systems that are as secure as possible; however, no delivery system is inherently secure. During periods of the Cold War, for example, the United States trailed every deployed Soviet ballistic missile submarine. In an era of rapidly advancing sensor technology, submarines and mobile land-based missiles may not remain invulnerable.

Countries at the forefront of modern counterforce technologies may continue to advocate for nuclear reductions—perhaps to mitigate global nuclear dangers, or perhaps to enhance their own offensive counterforce options. Countries that are lagging behind will likely resist those proposals. The development of modern counterforce capabilities, however, is overturning the logic of traditional arms control arguments.

Double-Edged Sword of Counterforce

The new era of nuclear arsenal vulnerability should reopen debates in the United States about the wisdom of developing effective counterforce systems. Fielding those capabilities—nuclear, conventional, and other—may prove invaluable by dissuading adversaries from initiating conventional conflicts; enhancing nuclear deterrence during conventional wars; and allowing the United States to defend itself and its allies if nuclear deterrence fails. Enhancing counterforce capabilities, however, may also trigger arms races and other dynamics (such as dangerous deployment modes) that exacerbate political and military risks.

In the past, the state of technology bolstered the case for proponents of nuclear restraint: after all, disarming strikes seemed impossible, so enhancing counterforce capabilities would trigger arms racing without creating useful military capabilities. Today, however, technological trends support the advocates of counterforce. Modern conventional military power

depends heavily on intelligence, surveillance, and reconnaissance (ISR) capabilities, as well as precision conventional weapons, but those capabilities are also the foundation of a counterforce arsenal. The United States will surely continue to enhance ISR and precision strike—as well as missile defenses, anti-submarine warfare, and cyber techniques—whether or not Washington decides to maximize its nuclear counterforce capabilities. In this new era of counterforce, arms racing therefore seems nearly inevitable, so exercising restraint may limit options without yielding much benefit.

Conclusion

Nuclear weapons are still the ultimate tools of deterrence. Even in the new era of counterforce, nuclear arsenals can be deployed in a manner that protects them from disarming strikes. But technological trends are making the nuclear deterrence mission more demanding, and hence widening the gap between stronger and weaker nuclear-armed countries. The most powerful countries should be able to deploy survivable deterrent forces and field potent counterforce capabilities, whereas relatively weaker countries with smaller nuclear arsenals will struggle to keep their forces secure. Moreover, the technological trends that are causing this shift show no signs of abating. Weapons will grow even more accurate, and sensors will continue to improve. How countries adapt to the new strategic landscape will greatly shape the prospects for international peace, stability, and conflict for years to come.

Related Resources

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