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# Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

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Middlebury Institute of International Studies

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# Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

April 2015

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**James Martin Center for Nonproliferation Studies**  
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# Table of Contents

<b>Acronyms</b> .....	<b>ii</b>
<b>Overview</b> .....	<b>1</b>
<b>Major Themes</b> .....	<b>1</b>
Theme 1: Early Developmental Status Leaves Open Questions of Feasibility .....	1
Theme 2: Absent Technical Information, Fears of HGVs are Impressionistic .....	2
Theme 3: Operational Aspects of HGVs are Not Well Understood.....	3
<b>U.S. Advanced Conventional Systems and Conventional Prompt Global Strike Ambitions: Assessing the Risks, Benefits, and Arms Control Implications</b> .....	<b>5</b>
<i>Dennis M. Gormley, University of Pittsburgh</i>	
<b>U.S. Thinking About the Role Such Systems Might Fulfill</b> .....	<b>5</b>
<b>Current Program Overview</b> .....	<b>8</b>
<b>Assessing the Risks of CPGS</b> .....	<b>11</b>
<b>Assessing the Benefits of CPGS</b> .....	<b>14</b>
<b>Alternatives to CPGS</b> .....	<b>16</b>
<b>A Role for Arms Control</b> .....	<b>17</b>
<b>Final Thoughts</b> .....	<b>20</b>
<b>Russia and Strategic, Conventional Weapons Concerns and Responses</b> .....	<b>21</b>
<i>James M. Acton, Carnegie Endowment for International Peace</i>	
<b>Russian Concerns</b> .....	<b>22</b>
<b>Russian Asymmetric Responses</b> .....	<b>28</b>
<b>Russian Symmetric Responses</b> .....	<b>29</b>
<b>Conclusion</b> .....	<b>33</b>
<b>Boost-glide Weapons and U.S.-Chinese Strategic Stability</b> .....	<b>34</b>
<i>Joshua Pollack, SAIC</i>	
<b>Hypersonic Weapons Development in China</b> .....	<b>34</b>
<b>U.S.-Chinese Strategic Dynamics</b> .....	<b>36</b>
<b>Pressures on Chinese Nuclear Posture</b> .....	<b>38</b>
<b>Potential Chinese Responses</b> .....	<b>39</b>
<b>Implications and Uncertainties</b> .....	<b>41</b>
<b>Appendix A: Workshop Agenda</b> .....	<b>43</b>
<b>Appendix B: Participants</b> .....	<b>44</b>

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## Acronyms

A2AD	Anti-access/area denial
AHW	Advanced Hypersonic Weapon (U.S. Army)
ASAT	Anti-satellite
ASBM	Anti-ship ballistic missile
BMD	Ballistic missile defense
CAS	China Academy of Sciences
CNS	James Martin Center for Nonproliferation Studies
CPGS	Conventional Prompt Global Strike
CSM	Conventional Strike Missile
CTM	Conventional Trident Modification
DARPA	Defense Advanced Research Projects Agency
DOD	Department of Defense
GAO	Government Accountability Office
HGV	Hypersonic Glide Vehicle
HTV-2	Hypersonic Technology Vehicle 2 (developed by DARPA and Lockheed Martin)
ICBM	Intercontinental ballistic missile
IRBM	Intermediate-range ballistic missile
LOW	Launch on warning
MaRV	Maneuverable re-entry vehicle
MIIS	Middlebury Institute of International Studies at Monterey
NFU	No First Use
NPR	Nuclear Posture Review
NRC	National Research Council
PASCC	Project on Advanced Systems and Concepts for Countering WMD
PLA	People's Liberation Army (China)
PLAN	People's Liberation Army – Navy (China)
QDR	Quadrennial Defense Review
SLBM	Submarine-launched ballistic missile
START	Strategic Arms Reduction Treaty
UGF	Underground facility
USAF	U.S. Air Force
USMC	U.S. Marine Corps
WMD	Weapons of mass destruction

## Overview

The United States, Russia, and China are all developing advanced conventional weapons often referred to as “hyper-glide” or “boost-glide” systems. Hypersonic glide vehicles (HGV) are those that travel at more than five times the speed of sound. “Glide” in this context refers to the behavior of the system as it reenters the earth’s atmosphere. Reentry is an extremely demanding environment, but the possibility of systems that can accurately deliver conventional payloads promptly over great distances or evade missile defenses presents obvious military advantages.

The impact of this new technology on strategic stability with Russia and China is only now beginning to command the attention of defense analysts. To examine the impact of hyper-glide systems on strategic stability, the James Martin Center for Nonproliferation Studies (CNS) at the Middlebury Institute of International Studies at Monterey (MIIS) conducted a yearlong study sponsored by the Naval Postgraduate School’s Project on Advanced Systems and Concepts for Countering Weapons of Mass Destruction (PASCC) via Assistance Grant/Agreement No. N00244-13-1-0031 awarded by the NAVSUP Fleet Logistics Center San Diego (NAVSUP FLC San Diego).

To complete this study, CNS commissioned three papers examining the impact of hyper-glide systems on strategic stability with Russia and China. CNS also hosted an unclassified, off-the-record workshop to discuss these papers in Washington, DC on 10 July 2014. The event included a review of what is publicly known about boost-glide and hypersonic vehicle programs around the world today; discussions of their implications for deterrence and strategic stability between the U.S., Russia, and China; potential offense-defense interactions; the military rationales for conventional prompt global strike (CPGS) weapons; other technologies that could play the CPGS role; and the potential for arms control, confidence-building, or transparency measures to address problems associated with a new class of strategic weapons.

In this report, the three commissioned papers follow a brief overview of the study’s themes and workshop results. The agenda for the workshop and the participant list are attached as Appendices A and B.

## Major Themes

Three major themes emerged from the study. First, hyper-glide programs remain developmental, leaving many questions about their feasibility and cost-effectiveness. Second, foreign concerns, especially those of Russia and China, are not tightly linked to specific programmatic facts about programs under development, but rather reflect general anxiety about the potential impact of new technologies. Third, operational aspects of hyper-glide systems, which will have the greatest impact on strategic stability, are not yet well understood. These topics were identified in working papers and dominated the discussions at the workshop.

### **Theme 1: Early Developmental Status Leaves Open Questions of Feasibility**

First, existing developmental programs have yet to demonstrate that hyper-glide technologies can generate reliable and cost-effective weapons systems. The United States and other powers are pursuing a number of technological paths toward hyper-glide systems. The United States has three service programs under development: the U.S. Air Force’s Conventional Strike Missile

## **Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions**

(CSM), the Defense Advanced Research Projects Agency's (DARPA) Hypersonic Test Vehicle no. 2 (HTV-2), and the U.S. Army's Advanced Hypersonic Weapon (AHW). According to Dennis Gormley, however, "a combination of risk, the effects of sequestration, and growing concern over China's military ambitions, most notably anti-access area-denial capabilities, make two of the three preceding...CPGS options problematic near-term solutions for the CPGS mission." Gormley explains that "the Air Force and DARPA programs have not demonstrated sufficient technical progress, while the financial basis for pursuing them has fallen prey to severe cuts in the Pentagon budget."

The concern over technical feasibility was a major theme at the workshop. One participant described the HTV-2 boost-glide development program as a high-risk, non-evolutionary approach that did not pay off. The high lift-to-drag ratio needed for a high-speed gliding object also introduces greater problems with heating and stress. The AHW hypersonic cruise missile program has been evolutionary, by contrast. Another participant stated that the exact amount of heating that the HTV-2 glider experienced came as a surprise. A third participant commented that different speeds and environments involve different physical "regimes" that we still need to understand. The participant closest to the HTV-2 program felt that there were no inherent challenges that advanced-technology states could not eventually overcome.

Many participants believed that the cost of these systems would make them a "niche" program only. The participant closest to defense policymaking in the current administration noted that the U.S. already has ample conventional stand-off capability. Further, the intelligence requirements for the "fleeting targets" that might justify highly prompt systems are very challenging. Medium-range, sea-based systems could be useful to overcome anti-access/area denial (A2AD) challenges. Another participant described this scenario as a "leading-edge attack." A third participant argued for CP GS-type systems to reduce the gap in time before the U.S. military could close with an adversary on short notice without using nuclear weapons. Few others present seemed persuaded that small numbers of conventional strikes via CP GS systems could provide a significant advantage that could not otherwise be realized through alternative means.

### **Theme 2: Absent Technical Information, Fears of HGVs are Impressionistic**

A second theme that emerged was that other powers, such as Russia and China, formed impressionistic fears about the impact of hyper-glide systems that are not strongly correlated with the actual technical capabilities or developmental status of current programs. These concerns reflect a broader concern about the development of advanced military capabilities. For example, James Acton notes in his commissioned paper that "Russian analysts have been very explicit in identifying a perceived threat from multiple forms of 'precision-guided weapons,' including 'long-range sea-launched and air-launched cruise missiles... and powerful air bombs and guided missiles, which can be delivered by U.S. heavy bombers and tactical aviation.'"

Participants at the workshop tended to agree that foreign concerns were often impressionistic and based on worst-case scenarios. The participant closest to defense policymaking stated that the Russians are "sincerely paranoid" about U.S. missile defense and CP GS investments, and are particularly worried about command and control decapitation and coercion in a crisis. The American statement during the New START talks that the U.S. did not consider the treaty as limiting boost-glide systems reinforced these concerns. Another participant described a recent

## **Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions**

Track 2 interaction with Russian experts, who displayed a budget document reflecting a large increase in air defense programs, reflecting Russian concerns about the U.S. and NATO. Acton notes in his paper that Russian analysts express concern that conventional hyper-glide systems could be armed with nuclear warheads.

Another participant described Chinese concerns about conventional counterforce and possible decapitation threats, and suggested that the deployment of CPGS-type systems could create incentives for the alteration of Chinese operational practices in order to address vulnerabilities early in a crisis. Such changes to Chinese practices might have implications for crisis stability, arms race stability, or overall relations, depending in large part on how the U.S. leadership interprets them. This is a theme Joshua Pollack develops in his paper, in which he argues, “If Chinese defense planners have come to regard this emerging ‘complex counterforce’ threat as sufficiently serious, it could influence both how Chinese leaders act in a crisis and how they choose to posture their strategic forces over the long term.”

Finally, one participant noted that foreign discussions of these programs tend to assume that any U.S. program that has ever appeared in a budget continues to be active in some form.

### **Theme 3: Operational Aspects of HGVs are Not Well Understood**

The third major theme to emerge was that the operational considerations that would influence strategic stability are only lightly appreciated. During the workshop, the idea that foreign perceptions were poorly linked to factual information about the status and capability of existing programs developed into a generalized observation that operational concepts, and their impact on strategic stability, were not yet well understood.

The general lack of clarity regarding operational aspects of potential future hyper-glide systems was clearly reflected in the workshop conversation. One participant claimed that boost-glide weapons flying in the upper atmosphere would differ from ballistic missiles because they would be difficult to detect after boost phase until they approached radar range. Another participant suggested that it would not be difficult to develop new space-based assets designed specifically to track the flight of boost-glide weapons, which would be hot, bright objects. A third participant observed that because boost-glide weapons would under-fly midcourse BMD systems, a substantial buildup of terminal-phase defenses would be required to counter them. Thus, an alternative to national coverage would be to invest in area defenses only. One candidate for area defense would be the radars associated with BMD systems. It is possible that existing endo-atmospheric interceptors could stop first-generation boost-glide weapons that did not maneuver in the terminal phase.

The question of “payload ambiguity,” or the idea that incoming missiles could not be identified as conventional or nuclear, was also addressed during the workshop. Many participants felt that the payload ambiguity question surrounding the Conventional Trident Modification (CTM) program was overstated. The CTM could have provided a near-term CPGS capability using already-built ballistic missiles rather than waiting for boost-glide weapons of the future. CTM would be covered by New START, but would not introduce treaty compliance problems in small numbers. If a near-term CPGS option is needed, some participants felt that revisiting CTM

## **Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions**

would be cost-effective and less problematic than developing an entirely new technology like boost-glide, whose maneuverability and perhaps also low detectability introduce a new class of “destination ambiguity” problems.

## U.S. Advanced Conventional Systems and Conventional Prompt Global Strike Ambitions: Assessing the Risks, Benefits, and Arms Control Implications

Dennis M. Gormley  
University of Pittsburgh

This paper examines the implications of U.S. interest in deploying advanced (high precision) conventional strike systems primarily to support the requirement to strike fleeting targets over distances of as much as intercontinental range for the purpose of destroying them in roughly one hour. America is not alone in pursuing such advanced conventional capabilities, as both Russia and China seem to possess similar ambitions. The American program is likely the most advanced at this time, and ample public information is available on these programs.<sup>1</sup> Given the state of knowledge about the status of U.S. programs, this paper focuses primarily on what has prompted the United States to pursue such programs, the potential risks and benefits of doing so, and the likely arms control implications of embracing such novel means of long-range conventional strike.

### U.S. Thinking About the Role Such Systems Might Fulfill

At present, the advanced conventional systems examined in this paper support the need for a “niche” capability consisting of a small number of conventional weapons that could very quickly be employed to destroy “fleeting” targets at the start or in the midst of a military campaign.<sup>2</sup> However, one could imagine more fulsome requirements under future administrations for such advanced high-precision long-range conventional weapons.

RAND strategist Albert Wohlstetter played a lead role at the beginning of the 1970s in supporting the Advanced Research Projects Agency’s Long-Range R&D project that foresaw the potential for radical future advances emanating from the revolution in microelectronics,

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<sup>1</sup> See Amy F. Woolf, “Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues,” Congressional Research Service Report for Congress, R-41464 (May 5, 2014); Joshua Pollack, “Evaluating Conventional Prompt Global Strike,” *Bulletin of the Atomic Scientists* 65, no. 1 (January/February 2009); James M. Acton, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike* (Carnegie Endowment for International Peace, 2013); and Dennis M. Gormley, “Sixty Minutes to Strike: Assessing the Risks, Benefits, and Arms Control Implications of Conventional Prompt Global Strike,” *Sicherheit und Frieden* (Security & Peace), no. 1 (January 2014).

<sup>2</sup> The formal requirement for CPGS weapons was established in May 2003. At that time, a quick-fix solution for the requirement for such a prompt weapon involved converting a portion of nuclear-armed submarine-launched ballistic missiles carried on Trident submarines into conventionally armed missiles. The Congress balked at such a course of action because of undesirable ambiguity over whether the missile might not be armed with a nuclear or conventional warhead. The Obama administration turned instead to emphasize much more advanced solutions under a Department of Defense program called “Defense-Wide Conventional Prompt Global Strike.” Three programs are included: the Air Force’s Conventional Strike Missile employing boost-glide technologies; the Defense Advanced Research Projects Agency (DAPRA) Hypersonic Test Vehicle No. 2; and the Army’s Advanced Hypersonic Weapon. An additional program sits outside of the Defense-wide program under DARPA’s direction—the X-51 Advanced Hypersonic Weapon, a scramjet-driven cruise missile.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

reconnaissance, communication, navigation and precise guidance for unmanned air systems that possessed increasingly long ranges.<sup>3</sup> This led later on, in the mid-1980s, to lively debates within strategic planning circles regarding options for implementing a so-called “Follow-On Forces Attack,” which at the outset of a Soviet ground invasion aimed to attack and thereby slow Soviet follow-on forces to improve NATO’s chances of coping with perceived Soviet conventional advantages.<sup>4</sup> Arguably the most provocative contribution to the notion of conventional global strike came from Paul Nitze, who was convinced by early 1994 that it was time for the United States to reconsider its longstanding reliance on nuclear weapons for deterrence. Nitze believed that U.S. presidents would no longer be willing to employ nuclear weapons to punish aggression and that precision-guided conventional weapons “will one day perform their primary mission of deterrence immeasurably better than nuclear weapons if only because we can—and will—use them.”<sup>5</sup>

An even more provocative version of long-range strategic conventional strike appeared two years after Paul Nitze’s contribution. Harlan K. Ullman and James P. Wade’s controversial book *Shock and Awe: Achieving Rapid Dominance* argues that rapid dominance over future adversaries required “a level of Shock and Awe . . . on an immediate or sufficiently timely basis to paralyze [an adversary’s] will to carry on.”<sup>6</sup> In an accompanying contribution to the book, General Chuck Horner (USAF, ret.), observes that “deep strike capabilities” are critically important “in a future world of surprise attack and withdrawal from foreign bases.” Such deep strikes, Horner believed, would require delivery systems with ranges up to 10,000 km.<sup>7</sup> Within a year after this controversial book appeared, the idea of arming intercontinental missiles with conventional warheads reappeared in the congressionally-mandated and bipartisan National Defense Panel, which was charged with reviewing and making recommendations to the Secretary of Defense on both the Quadrennial Defense Review (QDR) as well as providing an assessment of alternative future force structures for the U.S. military through the year 2010. The Panel recommended that such conventionally armed ICBMs could provide “a supplement or alternative to nuclear arsenals of the Cold War.” The quest to give meaning to the idea of conventional strategic strike finally manifested itself in President George W. Bush’s Nuclear Posture Review (NPR), announced in late December 2001. The document sought to conflate previously nuclear-only attack options into a new concept called “Global Strike,” thus bringing together advanced conventional and tailored nuclear strike options to deal with various regional contingencies requiring prompt decision-making.<sup>8</sup>

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<sup>3</sup> In September of 1972 I joined Harry Diamond Laboratories where many of these revolutionary new developments were significantly advanced. I subsequently worked off and on with Albert Wohlstetter until his death in 1997 on projects that foresaw how many of these advanced conventional weapon concepts would eventually develop.

<sup>4</sup> U.S. Congress, Office of Technology Assessment, *New Technology for NATO: Implementing Follow-On Forces Attack*, OTA-ISC-309 (Washington, D.C.: U.S. Government Printing Office, June 1987).

<sup>5</sup> Paul H. Nitze, “Is It Time to Junk Our Nukes?” *Washington Post*, January 16, 1994, C1.

<sup>6</sup> Harlan K. Ullman and James P. Wade, *Shock and Awe: Achieving Rapid Dominance* (Washington, D.C.: NDU Press, 1996). [http://www.dodccrp.org/files/Ullman\\_Shock.pdf](http://www.dodccrp.org/files/Ullman_Shock.pdf).

<sup>7</sup> *Ibid.*, 128 and 131.

<sup>8</sup> The conventional component was to consist of air and ship-launched cruise missiles and regional based attack aircraft. Still, nuclear options were seen as needed to deal with such targets as deeply buried strategic facilities housing weapons of mass destruction. *Ibid.*, 7. Shortly after the release of the Bush NPR, the U.S. Air Force Space Command established a requirement for a prompt global strike capability that could strike anywhere globally and defeat, via conventional means, such difficult targets as hard and deeply buried facilities and strategic relocatable targets, presumably nuclear-armed mobile missiles. See Dennis M. Gormley, “Conventional Force Integration in

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

The Bush administration's stab at deploying two conventional missiles on each of its 12 Trident submarines (with each missile equipped to carry four conventional warheads), while the remaining missiles would still carry nuclear warheads, proved unacceptable to Congress because of the nuclear ambiguity issue. According to one congressional staff member of the Senate Armed Services Committee, the demise of Trident's conversion suggested that there was no longer any prospect for either Trident submarine-launched ballistic missiles (SLBMs) or Minuteman land-based ballistic missiles undergoing conversion in support of the CPGS mission.<sup>9</sup> Interestingly, a National Research Council (NRC) review of the CPGS program essentially sank the Trident conversion program by arguing that the nuclear ambiguity issue could never be completely resolved. The report noted that the Department of Defense had presented panel members with scenarios in which CPGS weapons could provide leading edge preemptive strike against targets far inland so as to "cripple an adversary's essential warfighting capabilities" before they could be used against U.S. forces.<sup>10</sup> The NRC panel saw CPGS's potential role in supporting major combat operations, but only in a qualified sense. The NRC correctly noted that such major military operations are likely to be accompanied by strategic warning and a buildup of regional forces. Moreover, the use of CPGS in the context of a major regional war could be misinterpreted as a nuclear rather than conventional attack, thereby fostering unwanted and strong escalatory incentives, especially if the CPGS system was delivered by a ballistic missile.<sup>11</sup>

A final contribution of note with respect to the future of CPGS came from Barry Watts in a long monograph published by the Center for Strategic and Budgetary Assessment in 2005.<sup>12</sup> Watts argues that long-range strike—more broadly cast than CPGS—is critically central to U.S. strategy. This is because of what Watts sees as "the growing ability of accurate, non-nuclear . . . munitions to achieve military effects comparable to nuclear weapons, *without* the collateral damage of nuclear employment. . . ." (Author emphasis).<sup>13</sup> Thus, unlike during the Cold War, Watts believes that precision conventional weapons can now be used for more than deterrence purposes. While Watts looks at this as good news, he is deeply concerned that the U.S. Air Force has not taken a sufficiently aggressive approach to maintaining America's long-range strike advantage, particularly over the mid- to long-term timeframe. Should the United States face a "second nuclear age" over the long run—consisting of cascading nuclear proliferation—it will forfeit a number of important strategic opportunities and challenges, asserts Watts. Consequently, America risks losing its current advantage in conventional strategic strike, which could slow its wish to achieve deep nuclear reductions and address the rise of Asian powers,

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Global Strike," in James J. Wirtz and Jeffrey Larsen, eds., *Nuclear Transformation: The New U.S. Nuclear Doctrine* (New York: Palgrave, 2005), 53-68.

<sup>9</sup> My thanks to Miles Pomper of the Middlebury Institute's James Martin Center for Nonproliferation Studies for this information.

<sup>10</sup> "Conventional Prompt Global Strike Capability," Letter Report of the National Research Council's Committee on Conventional Prompt Global Strike Capability, May 11, 2007.

<http://www.nap.edu/catalog/11951.html>.

<sup>11</sup> *Ibid.*

<sup>12</sup> Barry D. Watts, *Long-Range Strike: Imperatives, Urgency, and Options* (Washington, D.C.: CSBA, 2005).

<http://www.csbaonline.org/publications/2005/04/long-range-strike-imperatives-urgency-and-options/> Watts served as Director of Program Analysis and Evaluation (PA&E) in the Pentagon from May 2001 to July 2002.

<sup>13</sup> *Ibid.*, i.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

among other things.<sup>14</sup> To take full advantage of U.S. core long-range strategic strike advantages, Watts believes that a better balance needs to be struck between heavy investments in short-range strike, where Air Force preferences lie, and long-range strike.

Watts distinguishes truly prompt long-range strike from less prompt long-range strike. In the former case, he sees only rare occasions when the need will arise to strike within a very short period of time. For these “rare occasions,” Watts would err on the side of cost and technical feasibility, which, he argues, favor an existing launch vehicle, such as Peacekeeper or Minuteman intercontinental ballistic missiles, coupled with a maneuverable hypersonic glide vehicle—also known as the Common Aero Vehicle or CAV—slated to carry around 450 kg of conventional munitions. Absent a turn for the worse toward a “second nuclear age,” Watts believes that it might be possible to avoid altogether the need for such a prompt strike capability because, in his view, the vast majority of long-range strike targets, even ones that are fleeting, can best be dealt with by a capability that permits loitering or dwelling close enough to where the target might emerge from hiding. Besides emphasizing the importance of long-range and survivability requirements, Watts avers that the chief problem regarding this challenge is determining how much speed is truly needed, either in regard to the long-range platform or its expendable munitions. In this regard, he argues that not more than Mach 2.5 would suffice.<sup>15</sup>

### Current Program Overview

Three key service programs are now center stage under the consolidated CPGS program. The U.S. Air Force began the Conventional Strike Missile (CSM) program in 2008, and after the demise of the U.S. Navy’s attempt to offer the Trident missile as the quickest and most effective path to a CPGS option, the Air Force CSM now occupies the lead position. Based on land—probably either on the U.S. west or east coast—the CSM would employ boost-glide technologies and follow a substantially lower depressed trajectory than existing nuclear-armed ballistic missiles. After separation, the payload would travel hypersonically to the target while having the capacity to execute substantial cross-range maneuver. Two benefits flow from such maneuverability: high accuracy and avoiding flight over hostile countries. The Air Force had hoped to reach an operational capability by 2012 (with one ready missile and two spares), but it now appears that the CSM might not be ready until well after the middle of this decade. This is due to the substantial testing that remains for reentry bodies that must undergo at least five demonstration flights. To date, the CSM has not undergone any successful hypersonic flight tests.<sup>16</sup>

The second CPGS contender is the Hypersonic Technology Vehicle no. 2 (HTV-2), funded by the Defense Advanced Research Projects Agency (DARPA). The goal of the HTV-2 is the development of a vehicle that can ride along the earth’s upper atmosphere at hypersonic speeds of more than 13,000 miles per hour. America’s largest defense contractor, Lockheed Martin, is developing the vehicle, which will also serve as the payload delivery vehicle for the Air Force CSM program. However, after two flight test failures (2010, 2011), and the brief achievement of

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<sup>14</sup> *Ibid.*, ii.

<sup>15</sup> *Ibid.*, iv.

<sup>16</sup> Woolf, Summary.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

a speed of Mach 20, it is clear that the vehicle thus far cannot maintain aerodynamic control for a full flight test, much less the entire objective mission distance. Given the tight defense budget that is likely to prevail for some time, the Pentagon decided to allocate a mere \$2m in the FY2014 budget, which will not support further HTV-2 testing while the Pentagon seeks a cheaper, less risky CPGS alternative.<sup>17</sup>

The third option under the consolidated Pentagon CPGS program is the U.S. Army's Advanced Hypersonic Weapon (AHW), which from the outset was seen as a way to reduce the risk associated with DARPA's HTV-2 endeavor. Indeed, the AHW's one flight test in November 2011 was successful, allowing the hypersonic glide vehicle to achieve a range of 2,400 miles. However, the program's most recent test on August 26, 2014 failed four seconds after launch "due to an anomaly."<sup>18</sup> Of course, the AHW's shorter range would necessitate forward deployment to meet the needs of the CPGS mission. Nevertheless, unlike its more challenging DARPA cousin, the army's AHW received Pentagon support for modest additional funding in FY2014 to permit one more test, which of course failed.<sup>19</sup> The consequences for further funding remain to be seen.

A combination of risk, the effects of sequestration, and growing concern over China's military ambitions, most notably anti-access area-denial capabilities, make two of the three preceding DOD-wide CPGS options problematic near-term solutions for the CPGS mission. The Air Force and DARPA programs have not demonstrated sufficient technical progress, while the financial basis for pursuing them has fallen prey to severe cuts in the Pentagon budget. The challenge of Chinese military modernization, on the other hand, has led to the Obama administration's modest "Pivot to East Asia" strategy announced in January 2012, amounting thus far to a rebalancing of only 180 U.S. Marines who arrived in Australia in April 2012, with a larger contingent of around 2,000 to possibly follow by 2017.<sup>20</sup> China's military challenge and the necessity to rebalance forces have re-focused attention on a sea-based CPGS option, but one without the launch ambiguity problem that led to the cancellation of the Conventional Trident Missile option in 2008. The FY2014 budget request for the CPGS program remains steadfast in its interest in sea-based options including a flight test of a navy variant of a CPGS system toward the end of 2016.<sup>21</sup> To avoid contaminating this sea-based option, were it to be affiliated with the Trident submarine's principal mission of nuclear delivery, Virginia-class attack submarines would instead be modified to accommodate a new intermediate-range ballistic missile (IRBM) intended for conventional delivery in at least two new launch tubes originally designed for carrying Tomahawk cruise missiles.<sup>22</sup> Although such a solution would lack the range and truly prompt

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<sup>17</sup> *Ibid.*, 18-19.

<sup>18</sup> "U.S. Army's Hypersonic Missile Fails During Test," *DefenseNews* [Digital Edition], August 26, 2014. <http://www.defensenews.com/article/20140825/DEFREG02/308250004/US-Army-s-Hypersonic-Missile-Fails-During-Test>.

<sup>19</sup> Woolf, 19-20.

<sup>20</sup> J. Dana Stuster, "The Obama administration just can't seem to pivot to Asia," *Foreign Policy*, June 7, 2013. [http://blog.foreignpolicy.com/posts/2013/06/07/the\\_obama\\_administration\\_just\\_cant\\_seem\\_to\\_get\\_its\\_asia\\_pivot\\_right](http://blog.foreignpolicy.com/posts/2013/06/07/the_obama_administration_just_cant_seem_to_get_its_asia_pivot_right).

<sup>21</sup> Woolf, *op. cit.*, 12.

<sup>22</sup> Elaine M. Grossman, "Pentagon Unveils New Plan for Conventional Submarine-Based Ballistic Missiles," *National Journal*, updated, May 29, 2013. <http://www.nationaljournal.com/nationalsecurity/pentagon-unveils-new-plan-for-conventional-submarine-based-ballistic-missiles-20120127>.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

response time of U.S.-based ICBMs, it might prove a more palatable solution, while still offering some modest support to the Obama pivot to East Asia strategy.

The Obama administration has embraced long-range conventional strike along with missile defenses as enabling America's interest in reducing its historic reliance on nuclear weapons. The 2010 NPR notes the important contributions that conventional weapons make to U.S. regional deterrence and reassurance goals. The document also signals to regional allies and friends that such conventional options are sufficiently critical that the United States will preserve options in the New START treaty for using heavy bombers and long-range missile systems in conventional roles.<sup>23</sup>

Russia initially sought to ban conventional warheads on strategic ballistic missiles, but the United States balked at the prohibition and instead agreed to a statement in the New START agreement's preamble indicating that both parties are "mindful of the impact of conventionally armed ICBMs [intercontinental ballistic missiles] and SLBMs [submarine-launched ballistic missiles] on strategic stability."<sup>24</sup> In the end, even though the treaty does not restrict conventionally armed ICBMs, it counts those delivery systems as treaty-limited strategic delivery systems under New START's ceiling of 1,550 nuclear warheads.<sup>25</sup>

The White House's interpretation of the New START treaty became evident in a February 20, 2011 report to Congress stipulating that while the treaty did count existing types of strategic delivery vehicles if they were converted to carry conventional warheads, this proviso did not apply equally to new types of delivery vehicles that do not "fly a ballistic trajectory over most of its flight path."<sup>26</sup> Accordingly, new types of warheads deployed on boost-glide systems, whose rocket-boosted payload delivery vehicles glide at hypersonic speeds in the atmosphere, would not be counted as nuclear warheads. The White House also acknowledged that it had at the time no plans to deploy conventionally armed ICBMs or SLBMs with traditional trajectories, which would be counted as nuclear systems under New START. On the other hand, it was investing in boost-glide systems launched by non-traditional boost vehicles to place a glide vehicle that would obtain hypersonic speeds while traveling in the earth's upper atmosphere before delivering its conventional payload. Although these new boost-glide systems are not subject to New START counting rules, the administration argues that they should avoid the ambiguity question because of their unique, non-ballistic flight profile. Yet, because such systems cannot be tracked and possess significant maneuverability after the boost phase, they still could present escalatory risks.<sup>27</sup>

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<sup>23</sup> *Nuclear Posture Review Report* (Washington, D.C.: U.S. Department of Defense: April 2010), 25.

<http://www.defense.gov/npr/>.

<sup>24</sup> "Treaty Between the United States of America and the Russian Federation for the Further Reduction and Limitation of Strategic Offensive Arms," April 8, 2010, 2. <http://www.state.gov/documents/organization/140035.pdf>.

<sup>25</sup> *Ibid.*, 4.

<sup>26</sup> Tom Z. Collina, "U.S. Alters Non-Nuclear Prompt-Strike Plan," *Arms Control Today*, April 11, 2011.

[http://www.armscontrol.org/act/2011\\_04/PromptStrike](http://www.armscontrol.org/act/2011_04/PromptStrike).

<sup>27</sup> James M. Acton, *Silver Bullet: Asking the Right Questions About Conventional Prompt Global Strike* (Washington, D.C.: Carnegie Endowment for International Peace, 2013), xiv.

### Assessing the Risks of CPGS

It seems evident that the prospective use case for such a niche CPGS capability falls into the category of a low probability but potentially high consequence eventuality. Analysts have used the case of al Qaeda's surprise attack on 9/11 and the consequent need for prompt response options as a justification for developing such capabilities. Admittedly, the U.S. military faced decided disadvantages vis-à-vis promptly striking fleeting al Qaeda targets. Yet the chances even today of having in hand all of the required intelligence support necessary to achieve success with one or several CPGS missiles seems highly doubtful. Indeed, subsequent analyses of what we knew about Osama bin Laden's location in Afghanistan after 9/11 points strongly to bin Laden being in Tora Bora, but not with enough accuracy to think that a few missiles would have succeeded in targeting him effectively. On the other hand, a higher probability of preventing bin Laden and his followers' escape into Pakistan certainly existed but was reportedly rejected by Secretary of Defense Donald Rumsfeld and General Tommy Franks, the regional commander-in-chief. They both perceived the risks of deviating from the light footprint, small-force plan they executed against Afghanistan as too high.<sup>28</sup> Obviously, there are other examples where promptly striking a fleeting, but temporarily fixed, target might seem imperative. The Pentagon's Defense Science Board outlined five representative cases, including responding to a U.S. satellite being shot down by a near-peer competitor; destroying nuclear materials that a terrorist organization had located temporarily in a neutral country; a small WMD package located temporarily in a neutral country; a fleeting terrorist group gathered temporarily in a neutral country; and a rogue state threatening to use a nuclear weapon against an allied nation.<sup>29</sup>

However compelling the argument for a prompt decision, the unintended but plausible consequences of deploying CPGS weapons seem formidable. The first is fear that arming ballistic missiles with conventional warheads might adversely affect strategic stability by virtue of the preemptive or preventive character of the weapon. Surely, any state perceiving that it is in the gun sights of a CPGS weapon might figure that it too needed to adjust its posture to achieve their own prompt capability. After the Bush administration elevated preemption/prevention to a national doctrine in 2002, a host of states followed suit, including both adversaries and some close allies of the United States, such as Japan.<sup>30</sup> Today, Japan seems bent on putting aside longstanding constitutional constraints on possessing offensive military forces, most notably an independent long-range strike capability—quite possibly ballistic missiles—to achieve preemptive results against such targets as North Korean missiles on high alert or Chinese forces preparing to invade the disputed Senkaku Islands.<sup>31</sup> U.S. fascination with CPGS deployments may have provided Japan welcome cover to turn to such an option itself.

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<sup>28</sup> "Tora Bora Revisited: How We Failed to Get Bin Laden and Why It Matters Today," A Report to Members of the Committee on Foreign Relations, United States Senate, 111<sup>th</sup> Congress, First Session, November 30, 2009. <http://www.gpo.gov/fdsys/pkg/CPRT-111SPRT53709/html/CPRT-111SPRT53709.htm>.

<sup>29</sup> Woolf, *op. cit.*, 5.

<sup>30</sup> These developments are discussed in Dennis M. Gormley, *Missile Contagion: Cruise Missile Proliferation and the Threat to International Security* (Westport, CT: Praeger Security International, 2008), 125-133 and 136-145.

<sup>31</sup> This is not the first time Japan has entertained developing a ballistic missile for preemptive purposes. In October 2004 the Japanese Defense Agency indicated interest in studying the need for such a capability, and then focused on enemy missile launch facilities. However, the plan was dropped soon after its acknowledgement due to coalition political pressure, and Japanese interest in such a strike capability turned to cruise missiles instead. On current Japanese long-range strike ambitions, see "U.S. worried by aggressive military posture," *Japan Times*, August 7,

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

Strategic stability is also threatened by the ambiguity over whether an incoming CPGS missile is armed with a conventional or nuclear payload. As noted at the outset, Russian analysts assert that CPGS augurs a future U.S. capacity to conduct effective counterforce strikes on their strategic nuclear forces, enabling the United States to threaten Russia's retaliatory capability without resort to nuclear weapons. If this perception prevails, then the potential for Russia mistakenly perceiving either one or two CPGS weapons as a leading edge attack—conventional or nuclear—against their nuclear arsenal is not entirely farfetched. Attempts to mitigate these worries through various confidence-building and transparency measures might allay some underlying concern pertaining to replacing a CPGS missile's conventional payload for a nuclear one. Still, such measures cannot confidently eliminate a state's potential for erratic behavior under the extraordinarily compressed circumstances of a CPGS scenario. Context, as always, is critical, but prompt decision-making comes with its own inherent dangers.

A second important dimension of risk lies in a firm appreciation of the important differences between nuclear and conventional weapons. The performance of a modest number of U.S. precision-guided munitions in the first Gulf War of 1991 augured the expectation that precision weapons might one day replace nuclear weapons for some missions. In 2008 one U.S. Strategic Command officer stated that conventional weapons were capable of destroying 10 to 30 percent of extant nuclear targets.<sup>32</sup> That said, proponents of nuclear weapons remain steadfast in their belief that the sheer scale of nuclear effects, compared with conventional weapons, contributes critically to their deterrent value. Whether one agrees or not with this distinction in regard to its outcome for deterrence, there is little debate about difference in scale and effects between nuclear and conventional weapons.

Thus, what separates nuclear from conventional weapons is the reality that their huge difference in scale greatly compensates for expected errors in weapon accuracy or target uncertainty. Compared with nuclear weapons, precision conventional weapons depend critically on an array of supporting needs. This includes, first and foremost, highly accurate and swiftly completed intelligence collection, analysis, and dissemination; rigorous mission planning; precise knowledge of the target's aim points (i.e., its vulnerabilities); post-attack damage assessment capabilities to determine whether or not damage objectives have been achieved and whether or not additional strikes are necessary; and, finally, an agile command and control system to manage these complex, interconnected tasks. Consequently, while nuclear weapons are forgiving due to their comparatively large-scale effects, conventional weapons, no matter how precise, cannot afford a breakdown in the performance of their supporting cast of functions if they are to succeed as planned. Therefore, while the sum of the CPGS concept's desired performance is certainly greater than the parts, each part critically enables the concept's objective synergy.

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2013, at <http://www.japantimes.co.jp/news/2013/08/07/national/u-s-fretting-over-japans-desire-to-militarily-strike-enemy-bases/#.UgfBcuBQNjA> and J. Michael Cole, "Japan Mulls a Preemptive Strike Capability," *The Diplomat*, June 4, 2013, at <http://thediplomat.com/flashpoints-blog/2013/06/04/japan-mulls-a-preemptive-strike-capability/>. On the earlier effort in 2004, see Gormley, *Missile Contagion*, 10.

<sup>32</sup> Elaine M. Grossman, "A Former Nuclear Commander Not Wild About Nukes," *Global Security Newswire*, May 28, 2008. <http://www.nti.org/gsn/article/a-former-nuclear-commander-not-wild-about-nukes/>

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

The disparate parts of the overall CPGS concept have yet to be articulated with clarity or introduced to all of the conceivable stakeholders within the U.S. military. This was the conclusion of a thorough investigation of the CPGS program by the U.S. Government Accountability Office (GAO) in 2008.<sup>33</sup> The study concentrated most on the disparate enabling technologies needed to make CPGS conceivable. They included, “Intelligence collection and dissemination, surveillance and reconnaissance, command and control, communications, and battlefield damage assessment.” The GAO found that the Pentagon had not coordinated its efforts to improve these critical enabling components of CPGS.

A third dimension to CPGS risk is its essential dependence on intelligence support. This facet of risk should be seen as the Achilles heel of the CPGS concept. Secretary of Defense Donald Rumsfeld, as noted, called for “exquisite” intelligence to support precise attacks a little less than 15 months before the invasion of Iraq occurred to destroy the inaccurately assessed stockpile of Iraqi WMDs.<sup>34</sup> General James Cartwright, formerly Vice Chairman of the Joint Chiefs of Staff, drew attention to the stiff demands of intelligence when he observed that success “encompasses . . . the ability to plan rapidly, to apply the precision to the intelligence and gather that intelligence in a very rapid manner.”<sup>35</sup> Yet, the fact that such decision-making and its accompanying planning may have to occur within an hour’s timeframe places unprecedented demands on the intelligence community. Commenting on the quality of intelligence needed to support CPGS use in 2007, CIA director General Michael Hayden observed, “if you are going to strike suddenly . . . it has to be based on very powerful, very convincing intelligence.”<sup>36</sup> Regarding General Hayden’s remarks, Amy Woolf added, “most analysts agree that the United States does not yet have the capability to meet the intelligence demands of the PGS mission.”<sup>37</sup>

One illustration underscores the dubiousness of ever meeting the CPGS concept’s enormously stiff intelligence demands—that of providing the president with a counterforce option against a rogue state’s decision to launch a nuclear missile. More often than not the implied or stated rogue state is North Korea, arguably the most opaque of all intelligence challenges. Both the South Korean and U.S. intelligence communities failed altogether to “promptly” detect the death, in 2011, of Kim Jong Il. Only several days after his death was announced on North Korean television did American decision-makers become aware of this critically important transition. Nor did the U.S. intelligence community promptly detect evidence that North Korea had undertaken the construction of a huge uranium enrichment facility until roughly 18 months after it began—and then only because U.S. physicist Siegfried Hecker of Stanford University was invited by North Korea to inspect the plant.<sup>38</sup> In principle, a missile launch might be more

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<sup>33</sup> U.S. Government Accountability Office, “Military Transformation: DOD Needs to Strengthen Implementation of Its Global Strike Concept and Provide a Comprehensive Investment Approach for Acquiring Needed Capabilities,” GAO-08-325, April 2008. Asked to comment on the GAO’s findings, the Department of Defense concurred with each of the GAO’s findings. In my experience as an advisor to several DARPA office directors during the 1990s, I found that technology considerations rather than conceptual ones virtually always dictated decision-making.

<sup>34</sup> On enduring intelligence weaknesses, see Dennis M. Gormley, “The Limits of Intelligence: Iraq’s Lessons,” *Survival*, Vol. 46, No. 3 (Autumn 2004), 7-28.

<sup>35</sup> Cited in Woolf, *op.cit.*, 4.

<sup>36</sup> *Ibid.*

<sup>37</sup> *Ibid.*

<sup>38</sup> Mark Landler and Choe Sang-Hun, “In Kim’s Undetected Death, Sign of Nation’s Opacity,” *New York Times*, December 19, 2011. <http://www.nytimes.com/2011/12/20/world/asia/in-detecting-kim-jong-il-death-a-gobal-intelligence-failure.html?pagewanted=all>.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

subject to detection than these examples, but knowing such details as, for example, whether or not the missile is armed with a nuclear warhead and precisely what are the intentions of North Korea's leadership are highly likely to remain opaque. Thus, taking a decision to launch a CPGS weapon under such circumstances is likely to be fraught with ambiguity and highly prone to unwanted mistakes.

Adding to the likelihood of intelligence error is the strong tendency within the inner councils of government decision-making to ignore information that is inconsistent with the desired consensus for a particular course of action. As Janne Nolan writes in *Tyranny of Consensus*, a new book that examines several cases of strategic surprise, "The premises guiding American strategic planning all too frequently prove to be at odds with the actual nature of the challenges involved—the so-called facts on the ground."<sup>39</sup> If the past is prologue to the future, historic failures to accurately comprehend the true character of the threats we have faced do not produce comfort about taking decisive action. This leaves decision-makers hardly any time to fully appraise the direct and potential unintended consequences of their actions.<sup>40</sup>

The last two administrations have endorsed the requirement for CPGS, though with differences in their articulation of just why such a capability is needed. The Bush administration seemed inclined toward a global strategic perspective, not least by joining the notion of strategic conventional capabilities with nuclear weapons to represent one of the three legs of the new 2002 triad. On the other hand, the Obama administration's support of the goal of nuclear abolition has fostered a more regional approach, yet one that by no means has caused the Obama White House to discard the idea of booster rockets and hypersonic glide vehicles capable of supporting global strikes in one hour's time. Pressed as it is to justify diminishing the importance of nuclear weapons, the Obama administration has correspondingly elevated the importance of the increasing U.S. dependence on its current and foreseeable advantages in conventional precision strike, prompt or otherwise. Yet, the question remains: are the benefits associated with procuring even a limited CPGS capability—much less a more fulsome one—worth the risks that might follow from employing or even possessing such a capability?

### Assessing the Benefits of CPGS

Both the Bush and Obama administrations have fixed on two chief benefits accruing to possessing the capacity to strike targets any place on earth within 60 minutes. The first is an admittedly rare low probability but high consequence situation wherein a fleeting terrorist target with a presumed nuclear weapon is detected in a neutral country. Alternatively, a rogue state such as North Korea—or perhaps in the future, Iran—places what appears to be a nuclear warhead on a missile capable of striking U.S. or allied territory. The second benefit deriving

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<sup>39</sup> Janne Nolan, *Tyranny of Consensus: Discourse and Dissent in American National Security Policy* (New York: The Century Foundation Press, 2013), 1.

<sup>40</sup> Take, for example, the Clinton administration's clumsy handling of a prompt response to al Qaeda's brazen attacks in Africa of two American embassies in August 1998. Cruise missiles were fired, without notable consequence, against six al Qaeda camps in Afghanistan and the Al Shifa pharmaceutical complex in Khartoum, Sudan, thought to be producing chemical weapons, but without full proof. The controversy over the 1998 attack—occurring during the Monica Lewinsky scandal—notably diminished the public's appreciation of the magnitude of the al Qaeda threat.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

from possessing a CPGS capability is that it reduces the possibility that the United States might have to employ nuclear weapons to defend its interests.<sup>41</sup>

The first benefit seems both remote and problematic in execution—and certainly a scenario for which alternative if less prompt means of response are widely available. But far more worrisome than such low probability threats occurring is the higher likelihood of mistakes emerging due to the sheer difficulty of possessing convincing intelligence but nonetheless taking preemptive action anyway. As noted earlier, preemptive strike doctrines coupled with long-range means of attack have spread widely on Northeast Asia, South Asia, and the Middle East to allies, friends, and potential enemies alike. Adding yet another hair-trigger capability, at the same time that the United States is strongly emphasizing the importance of “strategic stability” as a critical component in reducing global nuclear stockpiles, is inconsistent with that objective and potentially dangerous.

Strategic stability may also be adversely affected due to the unintended consequences of possessing a first-strike weapon, albeit a conventional one, that in principal threatens a rogue state’s nuclear capability. In 2002, President George W. Bush branded Iraq, North Korea, and Iran as comprising an “axis of evil,” and then ordered a preemptive invasion of Iraq in 2003. There is little doubt that such a decision exacerbated North Korea and Iran’s security dilemma and accelerated at least North Korea’s quest to achieve its nuclear objectives.<sup>42</sup> Facing a “bolt-out-of-the-blue” CPGS is likely to drive such threatened states to eventually place their own limited nuclear capability on hair-trigger alert.<sup>43</sup> Fostering such “use it or lose it” incentives is surely not what even promoters of CPGS originally had in mind, but it’s nonetheless likely to accompany any decision to deploy even a niche CPGS capability.

The second benefit assumed to apply to CPGS is avoiding the necessity to call upon using nuclear weapons instead. But what is the likelihood that any of the scenarios that might justify deploying a capability to execute a precision conventional strike any place on earth in 60 minutes would alternatively merit first use of nuclear weapons by an American president? Indeed, since the Obama administration took office in January 2009, there has been a modest turn toward looking at reducing the role of nuclear weapons to one of last resort—useful only as an ultimate reserve option to threaten retaliation in response to a nuclear attack on the United States or its allies. It is also important to recall that even Paul Nitze, in his 1994 article, argued that while conventional smart weapons would suffice for deterrence purposes, nuclear weapons were unlikely to deter regional aggressors and that U.S. presidents would be unwilling to use them to punish aggression.<sup>44</sup> Other senior decision-makers would seem to agree. Secretary of Defense

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<sup>41</sup> Woolf, *op. cit.*, 39.

<sup>42</sup> The 2007 National Intelligence Estimate on Iran’s nuclear programs judged that Iran had halted its nuclear weapons program in 2003, which lasted at least several years. See [http://www.dni.gov/files/documents/Newsroom/Reports%20and%20Pubs/20071203\\_release.pdf](http://www.dni.gov/files/documents/Newsroom/Reports%20and%20Pubs/20071203_release.pdf).

<sup>43</sup> Such a hair-trigger capability would require such states to possess a solid-fuel delivery system, which over the next decade seems unlikely in the case of North Korea. Iran, on the other hand, has tested a solid propellant 2,200km-range ballistic missile, the Sajjil-2, which are far less vulnerable to preemptive U.S. attacks and also provide Iran, in the future, the capacity to conduct preemptive attacks of its own due to their short readiness times compared with liquid-fuel missiles. See *Iran’s Ballistic Missile Capabilities: A Net Assessment* (London: IISS, 2010).

<sup>44</sup> Nitze, *op. cit.*

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

Robert McNamara and Secretary of State Dean Rusk both came to view nuclear weapons as essentially “unthinkable” for political and moral as well as military reasons.<sup>45</sup> After the 1991 Gulf War, Colin Powell dismissed the utility of nuclear use, while his commander-in-chief, President George H.W. Bush, acknowledged in his memoir, co-written with his national security advisor Brent Scowcroft, that he had ruled out a nuclear response in the 1991 Gulf War.<sup>46</sup>

However, because of the risks and ambiguities associated with CPGS, instead of making nuclear weapons use more remote, they risk increasing the chances of them being used. Thus, rather than reducing the circumstances under which the United States might have to resort to nuclear use, particularly for the kind of scenarios (fleeting terrorist groups with WMD or a rogue state apparently brandishing a nuclear missile) that CPGS supporters worry about, possessing CPGS weapons could actually increase the number of circumstances where the United States might have to resort to nuclear use.

### Alternatives to CPGS

If the risks outweigh the benefits of deploying CPGS systems, as argued here, are there conventional alternatives that might in fact compensate for refraining from deploying CPGS systems? There are a variety of conventional weapon systems that would take longer to reach the intended target but would compensate in a variety of ways. As Barry Watts has argued, most targets, especially fleeting ones, would be more readily detected were the weapon system capable of loitering once it reaches the target area. And during the time differential between a CPGS and its slower alternative, the latter system could be updated with the latest intelligence on the intended target’s location. Although the American Tomahawk cruise missile has been around since the 1970s, the current Block IV Tomahawk, called the “Tactical Tomahawk,” can be remotely controlled after launch to redirect the missile to an entirely new target. The latest version of the missile, which costs roughly half of its predecessor, can be programmed at launch to attack 15 different targets as well as to redirect to a newly detected one. Equipped with a video camera, the Tactical Tomahawk can loiter for hours over the target area, awaiting the emergence of its target. Without even considering what U.S. Air Force systems might contribute, Table I, below, indicates that there are ample stores of Tomahawk cruise missiles available to support U.S. security needs. Each of the four recently converted Ohio-class ballistic missile submarines, now called guided missile submarines or SSGNs, can carry up to 154 Tactical Tomahawks, up to 102 special forces troops, mini subs for covert SEAL units, and small UAVs for supporting reconnaissance needs. Perhaps most important of all, and unlike previous Tomahawk missiles, the new Tactical Tomahawk has greatly reduced the amount of time it takes to plan a mission, which reportedly now requires just 60 minutes.<sup>47</sup>

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<sup>45</sup> Nina Tannenwald, “Stigmatizing the Bomb,” *International Security*, Vol. 29, No. 4 (Spring 2005), 30.

<sup>46</sup> See Colin Powell with Joseph E. Perisco, *My American Journey: An Autobiography* (New York: Random House, 1995), 323-324, 485-486, and 540-541 and George H.W. Bush and Brent Scowcroft, *A World Transformed* (New York: Knopf, 1998), 463.

<sup>47</sup> Steven Russell, “Stick with Tomahawk, Forget LRASM,” *Breaking Defense*, online, July 12, 2013. <http://breakingdefense.com/2013/07/12/stick-with-the-tomahawk-forget-lrasm/>

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

If for some reason an SSGN were not patrolling within reach of a fleeting target of supreme interest that warrants a prompt conventional strike, the U.S. Air Force possesses ample stockpiles of AGM-86 cruise missiles, and has announced plans for a new cruise missile to replace it, possibly with all of the features that make the Tactical Tomahawk suitable for loitering and target reprogramming. In sum, the alternative conventional means of attack, when compared to the benefits and dangers associated with CPGS weapons, suggest that the United States can safely forgo deployment of CPGS weapons.

Table 1. Potential Tomahawk Cruise Missiles for Contingency Use

<i>Cruise Missile Carriers</i>	<i>Ships/Subs</i>	<i>Total Missiles</i>
Providence-class submarine	24	480
Seawolf-class submarine	3	60
Virginia-class submarine	22	440
Ohio-class SSGN submarine	4	616
CG-52-73 Ticonderoga	22	1,342
DDG-51 Arleigh Burke	72	3,240
DDG-1000 Zumwalt	3	120
Total	150	6,276

Note: For vessels with the Mk. 41 Vertical Launcher, half the cells are for cruise missiles. This chart is modified from Dr. Eugene Miasnikov, “The Air-Space Threat to Russia.”<sup>48</sup>

### A Role for Arms Control

A critically important motivating factor in examining CPGS weapons is to allay Russian concerns that American conventional superiority will threaten their nuclear arsenals as future reductions take place along the path to either very low numbers (e.g., a few hundred) or complete abolition of nuclear weapons. CPGS delivery systems equipped with appropriately designed penetrators and possessing an accuracy of five meters could, in principle, threaten Russian silo-based nuclear missiles. Indeed, Russian analyses argue that the combination of uncontrolled American missile defenses and conventional strategic arms (notably, CPGS and Tomahawk cruise missiles) threaten the survivability of their strategic nuclear arsenal—especially as the arsenal grows smaller with deeper nuclear cuts.<sup>49</sup>

Before addressing what type of controls and measures may be required to allay concerns about American conventional strike systems, it is important to note once again the differences between nuclear and conventional weapons. Briefly put, compared with precision conventional weapons, nuclear weapons are vastly more unforgiving due to the sheer scale of their damage. They also depend far less than conventional weapons do on a host of supporting functions, any one of which, should it fail, would lead to systemic malfunction. Where two nuclear ICBMs may

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<sup>48</sup> Eugene Miasnikov, “The Air-Space Threat to Russia,” in Alexei Arbatov and Vladimir Dvorkin, eds., *Missile Defense: Confrontation and Cooperation* (Moscow: Carnegie Moscow Center, 2013).  
[http://carnegieendowment.org/files/Missile\\_Defense\\_book\\_eng\\_fin2013.pdf](http://carnegieendowment.org/files/Missile_Defense_book_eng_fin2013.pdf)

<sup>49</sup> See Ibid.; Eugene Miasnikov, “Counterforce Capabilities of Conventional Strategic Arms,” Presentation at ISODARCO XXVI Winter Course “New Military Technologies: Implications for Strategy and Arms Control, January 6-13, 2013, at [www.armscontrol.ru/pubs/en/Miasnikov-PGM-130110.pdf](http://www.armscontrol.ru/pubs/en/Miasnikov-PGM-130110.pdf).

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

suffice to achieve a high probability of disabling a Russian ICBM silo, as many as five to nine CPGS missiles, according to one Russian calculation, would likely be needed to achieve roughly the same outcome.<sup>50</sup> This begs the question—admittedly one more political than technical—of how or why any sane U.S. president could be convinced to count on achieving perfect or near-perfect success in any conventional counterforce strike against Russian nuclear targets, on land, at sea, and in the air. The consequences of imperfection are unacceptable and devastating; that is, the near certain probability of Russian nuclear missiles destroying major American cities, with millions of deaths. The Russian media is replete with stories about Russian ICBMs being capable of making evasive maneuvers against missile defenses, as well as carrying countermeasures and decoys to assure penetration of even thick defenses, no less the decidedly limited type of U.S. missile defense system now deployed in Alaska and California.<sup>51</sup>

Russian analysts evoke grave concern about the ability of American Tomahawk cruise missiles—particularly the Block IV Tactical Tomahawk—to disable their ICBM silos were they to be equipped with shaped-charge rather than blast fragmentation warheads, as some of them are today.<sup>52</sup> Nevertheless, Russia could respond to such a threat by ringing their silo fields with S-400 anti-aircraft systems to furnish point defense against such a slow-flying system as a Tomahawk missile. That measure alone would surely inject sufficient uncertainty about achieving perfect or near-perfect success for any such large-scale attack. Nevertheless, Russian analysts view this scenario as conceivable, citing American experts who claim that a missile defense of the U.S. national territory would be virtually impossible.<sup>53</sup> While such an argument with respect to full territorial defense is quite true, defending against selected point targets—namely, Russian nuclear missile silos—is a much more achievable task. Indeed, both the S-300 and S-400 are reputed to possess counter-cruise missile capability.<sup>54</sup> In short, missile defense uncertainties cut both ways, affecting American and Russian security planners alike, particularly in the case of non-nuclear planning, where military outcomes are likely to be much longer in duration.

In considering to what extent the United States should accommodate Russian concerns about counterforce capabilities of CPGS and cruise missile systems in future bilateral negotiations, it is

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<sup>50</sup> *Ibid.*, 16. For a contrasting analysis of U.S. counterforce conventional strikes on Chinese nuclear forces, which reaches a different conclusion, see Tong Zhao, “Limiting Damage or Damaging Stability: Assessing Conventional Counterforce Strikes against Theater Nuclear Forces,” in Stephanie Spies and Mark Jansson, eds., *Project on Nuclear Issues: A Collection of Papers from the 2011 Conference Series* (Washington, D.C.: Center for Strategic and International Studies, 2012), 140-155, at [http://csis.org/files/publication/120809\\_Spies\\_ProjectNuclearIssues\\_web.pdf](http://csis.org/files/publication/120809_Spies_ProjectNuclearIssues_web.pdf).

<sup>51</sup> On Russian countermeasures, see “Russia to Get New ICBM Later This Year,” *RIA NOVOSTI*, April 18, 2013, [http://en.rian.ru/military\\_news/20130418/180717057.html](http://en.rian.ru/military_news/20130418/180717057.html).

<sup>52</sup> An unknown portion of Tactical Tomahawk inventory is slated to be equipped with this so-called “penetrator variant,” designed to deal with hardened and underground targets. See <http://www.designation-systems.net/dusrm/m-109.html>. The Navy is also working on a multi-effects warhead system that would combine a blast fragmentation capability with a tandem penetrator, meaning all Block IV Tomahawks could eventually be outfitted with duel-mode warheads. Still, several missiles would likely be needed to obtain the required damage effects against a missile silo, much less to deal with preferential silo defenses.

<sup>53</sup> Miasnikov, “The Air-Space Threat to Russia,” 127.

<sup>54</sup> For technical details of the S-400, see Carlo Kopp, “Almaz-Antey 40R6/S-400 Triumf Self Propelled Air Defence System/SA-21,” Technical Report APA-TR-2009-0503, May 2009. <http://www.ausairpower.net/APA-S-400-Triumf.html>

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

important to review what the New START treaty of 2010 concluded with respect to Russian concerns. In negotiations, the United States reportedly told the Russian side that they did not plan to deploy enough CPGS systems to threaten Russia's strategic retaliatory capability.<sup>55</sup> The preamble to the treaty, however, does state that both countries are "mindful of the impact of conventionally armed ICBMs and SLBMs on strategic stability."<sup>56</sup> The U.S. side was willing to count ballistic missiles armed with conventional warheads in the treaty's limits as if they were nuclear. Importantly, this was done not because the U.S. side agreed with Russian concerns about the counterforce potential of such conventional weapons; rather, should the United States proceed to arm previously nuclear ballistic missiles with a conventional payload, it would be virtually impossible to know the difference between a nuclear- and conventional-armed missile, rendering treaty compliance problematic.<sup>57</sup>

Should the Pentagon proceed to deploy what is very likely to be a niche capability, extant New START counting rules would apply if the choice is a missile that delivers reentry vehicle(s) on a ballistic missile trajectory. On the other hand, were the United States to deploy a boost-glide CPGS weapon—launched along a depressed trajectory using a hypersonic glide vehicle to deliver its weapons to the target—this new type of system would not be subject to New START counting rules. This is because the U.S. position is that unlike traditional ballistic missiles, the Russians could readily detect the difference, thus avoiding the threat ambiguity issue. But as James Acton has argued, such boost-glide systems still present escalatory risks. Still, in the case of a U.S. wish to deploy such a non-ballistic system, New START provides Russia with the right to question, in a Bilateral Consultation Commission, whether or not such a weapon should be subject to extant counting rules.<sup>58</sup> As long as the United States remains committed simply to a niche capability, consenting to counting rules for such a limited deployment of boost-glide systems seems eminently reasonable.<sup>59</sup> Should a future U.S. administration wish to deploy larger numbers of CPGS weapons, they should still be subject to counting rules despite the fact that larger numbers affect the size of the U.S. nuclear arsenal, which may prove difficult to accept for those nuclear advocates who today cannot imagine a stable world once nuclear arsenals dip below the level of 1,000 weapons.

Russia's concerns about threats emanating from large-scale Tomahawk deployments are not covered under New START. Transparency measures, including U.S.-Russian expert discussions about the feasibility and risks of various threat scenarios of concern to Russia, need to take place to allay Russian concern about the cruise missile threat. As noted before, Russian deployments of S-300/400 missile defenses would render the execution of such a threat dubious and incredibly risky. These concerns might grow over time, however, particularly as technologies emerge that might permit hypersonic cruise missiles—perhaps some with even global strike ranges—to become conceivable. As one possible measure to calm Russian fears, limiting the patrol areas of U.S. submarines—notably SSGNs each carrying 154 cruise missiles—to operate outside the 200 nautical mile exclusive economic zone, which would effectively place enough SSGNs in a

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<sup>55</sup> Woolf, *op.cit.*, 37.

<sup>56</sup> Cited in *ibid.*

<sup>57</sup> *Ibid.*

<sup>58</sup> Under Article 5 of the treaty, the U.S. would still reserve the right to develop and test such a weapon.

<sup>59</sup> Recalling the provenance of CPGS, Russia surely assumes that a future U.S. administration might be prone to go down a more robust path than perhaps the current administration is willing to entertain.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

location where they are incapable of targeting Russian missile silos may be a useful idea to consider.<sup>60</sup> Indeed, if hypersonic cruise missiles were to become capable of being launched from submarines, their range would be unlikely to match the current Tomahawk range of 2,500km, making even fewer if any Russian silos vulnerable to such a threat.

### Final Thoughts

The only thing certain about future nuclear reductions is that they will require an unprecedented level of dialogue and transparency between and among the affected state parties to reach some accommodation that enables deeper cuts in each side's nuclear arsenal. To achieve progress, parties must abstain from exaggeration by appreciating the distinction between what is hypothetically possible and realistically achievable when evaluating threat scenarios of gravest concern.

But what seems certain is that making heretofore nuclear-only missiles also capable of delivering conventional warheads is fraught with the prospect of serious unintended consequences. For one example particularly pertinent to this paper, we must keep squarely in mind that to the extent that state parties to the Missile Technology Control Regime begin embracing the use of ballistic missiles for conventional missions—and even worse, for missions with only one hour of decision time before use—a strong precedent will be set for other states to emulate such behavior. One can surmise that the reason why cruise missiles did not find their way into the 2002 Hague Code of Conduct against the Proliferation of Ballistic Missiles is that they were seen, especially by the Pentagon, as a weapon of great discrimination rather than mass destruction. Ballistic missiles may gain a similar reputation, even though everyone knows that both ballistic and cruise missiles are equally capable of delivering nuclear, biological, and chemical weapons. Nevertheless, the consequence may be the unintended spread of ballistic missiles and accompanying strategic instability. Thus, when U.S. decisionmakers pause to consider the ramifications of any decision about deploying CPGS systems, they should broaden the scope of their perspective to include the effects on nonproliferation policy and missile proliferation.<sup>61</sup>

Finally, the notion of prompt use of a highly precise intercontinental-range missile within an hour's decision time powerfully conveys the longstanding American preference for dabbling with technological solutions to the exclusion of clear-headed strategic thinking. Here, American decision-makers would best avoid myopic thinking about the utility of CPGS as a silver bullet. It would be preferable to consider more fully the broad and unwelcome dangers and policy ramifications that could very well result from such narrow thinking.

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<sup>60</sup> Dennis M. Gormley, "The Path to Deep Nuclear Reductions: Dealing with American Conventional Superiority," *Proliferation Papers*, No. 29, Fall 2009, 43-44.

<sup>61</sup> Some analysts have argued that in light of China's conventional missile buildup and the consequent threat to U.S. and allied forces in the region, it would serve U.S. interests to abandon the Intermediate Nuclear Forces Treaty (INF) signed in 1987. Recent developments in Russia also suggest a most uncertain future for INF treaty's longevity. Still, on balance there are compelling reasons to believe that a U.S. land-based intermediate-range ballistic missile force deployed against China would not offer much value over existing and more varied U.S. strike options. For one assessment reaching such a conclusion, see David W. Kern, Jr., *Facing the Missile Challenge: U.S. Strategy and the Future of the INF Treaty* (Santa Monica, CA: RAND, 2012).

## Russia and Strategic, Conventional Weapons Concerns and Responses

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Russian President Vladimir Putin must have a special place in his heart for the United States' Conventional Prompt Global Strike program.<sup>62</sup> He has publicly decried American plans to develop hypersonic, long-range, non-nuclear munitions on at least five occasions since they were first unveiled in 2006—including at such high-profile occasions as his State of the Nation address in December 2013.<sup>63</sup> In that speech, he called the CPGS program out by name and stated that, in combination with ballistic missile defense, it “could negate all previous agreements on the limitation and reduction of strategic nuclear weapons, and disrupt the strategic balance of power.”<sup>64</sup>

The level of personal attention that Putin is paying to the CPGS program is remarkable. To be sure, CPGS is hardly unique among U.S. weapon development efforts in attracting the Kremlin's ire; Putin has complained about U.S. ballistic missile defense efforts far more often and just as hyperbolically. Rather, what is noteworthy is the deep level of concern that Russia's president has for weapons that the United States has not yet decided to acquire, that are at least a decade away from deployment should a decision to procure them be made, and that have failed—either wholly or partially—in five or six of just seven tests to date.<sup>65</sup>

To explain Putin's interest, it is necessary to understand that there is a deeply embedded belief among many Russian officials and analysts that the development of prompt, long-range, conventional weapons marks a fundamental turning point in the nature of warfare. This belief

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<sup>62</sup> Some of the material in this paper originally appeared in James M. Acton, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike* (Washington, DC: Carnegie Endowment for International Peace, 2013). <http://carnegieendowment.org/files/cpgs.pdf>. It has been extensively revised for this publication.

<sup>63</sup> Vladimir Putin, remarks at meeting on “Drafting the 2016-2025 State Armament Programme,” September 10, 2014, Moscow (official translation available from <http://eng.kremlin.ru/transcripts/22930>); Vladimir Putin, address to the Federal Assembly, Moscow, December 12, 2013 (official translation available from <http://eng.kremlin.ru/transcripts/6402>); Vladimir Putin, remarks at meeting on “Implementing the 2011-2020 State Arms Procurement Programme,” St. Petersburg, June 19, 2013 (official translation available from <http://eng.kremlin.ru/transcripts/5615>); Vladimir Putin, “Being Strong: National Security Guarantees for Russia,” *Rossiiskaya Gazeta*, February 19, 2012 (translation available from <http://rt.com/politics/official-word/strong-putin-military-russia-711>); Vladimir Putin, address to the Federal Assembly, Moscow, May 10, 2006 (official translation available from [http://archive.kremlin.ru/eng/speeches/2006/05/10/1823\\_type70029type82912\\_105566.shtml](http://archive.kremlin.ru/eng/speeches/2006/05/10/1823_type70029type82912_105566.shtml)).

<sup>64</sup> Putin, address to the Federal Assembly, 2013.

<sup>65</sup> This figure includes three tests within the Enhanced Effectiveness (E2) and Life Extension Test Bed (LETB) programs (which were intended to develop a terminally guided ballistic missile), two tests of the Hypersonic Technology Vehicle-2 (HTV-2) and two tests of the Advanced Hypersonic Weapon (AHW). The U.S. Department of Defense has stated that the 2011 AHW test was a success. The outcome of the 2009 LETB test is not known publicly. Acton, *Silver Bullet?*, 38 and 43; David Alexander and Andrea Shalal, “Experimental U.S. Hypersonic Weapon Destroyed Seconds After Launch,” Reuters, August 25, 2014. <http://www.reuters.com/article/2014/08/25/us-usa-military-hypersonic-idUSKBN0GP1ED20140825>

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

creates deep concern in Russia on multiple levels and is already affecting Russia's military posture. It also appears to be sparking Russia's development of its own CPGS-like weapons.

### Russian Concerns

Russian analysts and officials tend to view hypersonic, long-range, non-nuclear weapons as part of a broader category of "strategic, conventional weapons." This term is rarely defined, but is often used broadly to encompass the full range of high-precision standoff capabilities, whether prompt or not.<sup>66</sup> As such, strategic, conventional weapons, which include cruise missiles and even guided gravity bombs, are already a reality for Russia.

That said, for Russia, hypersonic weapons do appear to represent the "most strategic" of conventional weapons. As Putin's remarks typify, Russia's primary concern in this regard appears to be the CPGS program, which is currently focused on the development of hypersonic boost-glide weapons but has funded research into terminally guided conventional ballistic missiles. However, hypersonic cruise missiles (which are a bureaucratically separate effort from CPGS within the United States) and orbital weapons (of which the reusable X-37B unmanned orbiter is viewed in Russia as a prototype) are also regarded as worrying potential additions to the U.S. arsenal of strategic, conventional weapons.<sup>67</sup>

There is a dramatic divergence between U.S. and Russian views about what Russia should worry about where hypersonic weapons are concerned. The most cogent argument within the United States against the development of certain hypersonic weapon systems has been the concern that Russia might mistake the launch of a conventionally armed system for a nuclear-armed system and launch a precipitous nuclear response.<sup>68</sup> This problem—often termed the warhead ambiguity problem—came to the fore in 2006 when the administration of George W. Bush announced plans to replace the nuclear warheads on some Trident-D5 sea-launched ballistic missiles with conventional munitions and was the ostensible reason that Congress refused funding for that program. As a result, the U.S. Department of Defense refocused its research and development efforts on boost-glide weapons, which, it argued, would be distinguishable from nuclear weapons by their non-ballistic trajectory (whether this argument will prove persuasive to Congress will be seen if and when it is asked to provide funding for the acquisition of boost-glide weapons).

Russian officials—including Putin himself—have raised the warhead ambiguity problem.<sup>69</sup> They have also raised the possibility that, because boost-glide weapons are highly maneuverable,

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<sup>66</sup> For example, Yevgeny Miasnikov, "Precision-Guided Conventional Weapons" in *Nuclear Reset: Arms Reduction and Nonproliferation*, eds. Alexei Arbatov and Vladimir Dvorkin, trans. ed. Natalia Bubnova, (Moscow: Carnegie Moscow Center, 2012), 434-42. [http://carnegieendowment.org/files/nuclear\\_reset\\_Book2012\\_web.pdf](http://carnegieendowment.org/files/nuclear_reset_Book2012_web.pdf)

<sup>67</sup> For example, Alexei Arbatov, *Gambit or Endgame? The New State of Arms Control*, Carnegie Paper (Moscow: Carnegie Moscow Center, March 2011), 16. [www.carnegieendowment.org/files/gambit\\_endgame.pdf](http://www.carnegieendowment.org/files/gambit_endgame.pdf); Alexei Arbatov and Vladimir Dvorkin, *The Great Strategic Triangle*, Carnegie Paper (Moscow: Carnegie Moscow Center, April 2013), 26. [http://carnegieendowment.org/files/strategic\\_triangle.pdf](http://carnegieendowment.org/files/strategic_triangle.pdf)

<sup>68</sup> Acton, *Silver Bullet?*, 113-8.

<sup>69</sup> Putin, address to the Russian Federal Assembly, 2006. See also Sergei Lavrov, "New START Treaty in the Global Security Matrix: The Political Dimension," *Mezhdunarodnaya Zhizn* 7 (July 2010) (official translation available from

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

Russia might mistake an attack against a state that borders Russia as an attack against Russia—a problem known as destination ambiguity in the American literature.<sup>70</sup> However, Russia has a number of other concerns, operating across at least six levels, many of which appear to be more acute. The first three relate to strategic, conventional weapons in general, though are particularly acute where hypersonic weapons are concerned.

### ***Strategic, conventional weapons could prove decisive in a major conflict and Russia is falling behind.***

The effectiveness of U.S. precision-guided munitions in the 1991 Gulf War provided a rude awakening for Russia (and many other states, including China). It clearly illustrated that improvements in accuracy had revolutionized *tactical* strike capabilities and that the United States enjoyed a huge lead in the relevant technologies. Now Russian strategists appear to have concluded that ongoing improvements in conventional weaponry are similarly revolutionizing *strategic* strike capabilities.

This belief appears to be held by even the most senior Russian decision-makers. For example, in a February 2012 article, Putin, who was Russia's prime minister at that point, argued that, while nuclear deterrence should prevent large-scale aggression against Russia,

We should take into account that technological progress in various areas, from new models of weapons and military hardware to information and communications technology, has fundamentally changed the nature of armed conflict. For instance, as high-precision long-range weapons with conventional charges become more common, they will become the means of achieving a decisive victory in conflicts, including a global conflict.<sup>71</sup>

Russian experts and officials are often vague about *how* non-nuclear weapons might enable their possessors to achieve a decisive victory in a major conflict. They sometimes point to the increased usability of conventional compared to nuclear weapons, or the possibility of a conventional “first strike” against Russia's nuclear forces (both of which are discussed further below). Most fundamentally, however, Russian strategists appear to believe that conventional weapons are now approaching nuclear weapons in their effectiveness. (Many American strategists, by contrast, argue that conventional weapons can now be employed for missions that have hitherto been exclusively nuclear; but very few argue that the two are directly comparable in their effects).

For example, on June 19, 2013—just hours before U.S. President Barack Obama called for further nuclear reductions in Berlin—Putin personally emphasized concerns about the ongoing development of “high-precision conventional weapons systems that in their strike capabilities

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[www.mid.ru/brp\\_4.nsf/e78a48070f128a7b43256999005bcbb3/25909cfe1bbd1c6ec325777500339245?OpenDocument](http://www.mid.ru/brp_4.nsf/e78a48070f128a7b43256999005bcbb3/25909cfe1bbd1c6ec325777500339245?OpenDocument)); Anatoly Antonov, “Russia Forced to Develop Global Prompt Strike Weapons,” *Security Index* 19, no. 3 (2013): 5.

<sup>70</sup> Yelena Chernenko, “Takiye Sistemy Budut Nosit’ Isklyuchitel’no Opasnyy Kharakter” [Such Systems Will Be Exceptionally Dangerous], interview with Sergei Ryabkov, *Kommersant*, December 12, 2013: 8. <http://kommersant.ru/doc/2366153>.

<sup>71</sup> Putin, “Being Strong.”

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

come close to strategic nuclear weapons” in a “pre-butal” of Obama’s proposals.<sup>72</sup> Five months later, he went even further, declaring that “the degree of precision and power of today’s high-precision weapons makes them essentially an alternative to nuclear weapons.”<sup>73</sup> On neither occasion did Putin specify exactly to which weapons he was referring. However, Deputy Defense Minister Anatoly Antonov was more specific in an April 2013 interview, stating that

The destructive capabilities of [CPGS weapons] are increasingly getting closer to those of nuclear weapons... incoming information unequivocally testifies to the fact that the United States is looking for a considerable new segment of its strategic arsenal capable of solving a wide range of tasks that used to be assigned exclusively to strategic nuclear weapons.<sup>74</sup>

Moreover, the potential equivalence of nuclear and conventional weapons appears to be reflected in Russia’s own 2010 Military Doctrine, which states, in somewhat oblique terms, that “in the context of the implementation by the Russian Federation of strategic deterrence measures of a forceful nature, provision is made for the utilization of precision weapons.”<sup>75</sup>

Concern about the destructive potential of hypersonic, long-range, conventional weapons is coupled with concern that Russia is lagging behind in their development. Russian Deputy Prime Minister Dmitry Rogozin reflected this fear in June 2013 when he is reported to have warned that Russia may “sleep through the new revolution.”<sup>76</sup>

***Strategic, conventional weapons—especially in combination with ballistic missile defense—could undermine the survivability of Russia’s nuclear forces.***

The concern about which Russian officials and analysts are most vocal is the possibility that their nuclear forces might become vulnerable to U.S. conventional forces. These concerns are not purely focused on CPGS. Russian analysts have been very explicit in identifying a perceived threat from multiple forms of “precision-guided weapons,” including “long-range sea-launched and air-launched cruise missiles...and powerful air bombs and guided missiles, which can be delivered by U.S. heavy bombers and tactical aviation.”<sup>77</sup> According to Vladimir Dvorkin, a retired Russian major general who served as head of a military institute devoted to modeling nuclear exchanges, such weapons “pose a threat to all branches of the strategic nuclear triad, including the silo and mobile launchers of the Strategic Rocket Forces..., strategic submarines in bases, and strategic bombers.”<sup>78</sup>

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<sup>72</sup> Putin, remarks at meeting on “Implementing the 2011-2020 State Arms Procurement Programme.”

<sup>73</sup> Vladimir Putin, remarks at meeting on “Developing High-Precision Weapons,” November 29, 2012, Sochi. <http://eng.kremlin.ru/transcripts/6346>

<sup>74</sup> Antonov, “Russia Forced to Develop Global Prompt Strike Weapons,” 4.

<sup>75</sup> *The Military Doctrine of the Russian Federation*, February 5, 2010, para. 22. (translation available from [http://carnegieendowment.org/files/2010russia\\_militaryDoctrine.pdf](http://carnegieendowment.org/files/2010russia_militaryDoctrine.pdf))

<sup>76</sup> Quoted in Yelena Chernenko and Ivan Safronov, “Razgonka Vooruzheniy” [The Arms Race Enters a New Stage], *Kommersant*, December 12, 2013: 8. <http://kommersant.ru/doc/2365917>

<sup>77</sup> Miasnikov, “Precision-Guided Conventional Weapons,” 432.

<sup>78</sup> Vladimir Dvorkin, “Reducing Russia’s Reliance on Nuclear Weapons in Security Policies,” in *Engaging China and Russia on Nuclear Disarmament*, eds. Cristina Hansell and William C. Potter, Occasional Paper 15, 100 (Monterey, CA: James Martin Center for Nonproliferation Studies, Monterey Institute of International Studies, 2009). <http://cns.miis.edu/opapers/op15/op15.pdf>

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

That said, over the last 18 months or so, there has been a very noticeable uptick of concern about the perceived potential impact of CPGS weapons on the survivability of Russia's nuclear forces. Putin's warning in his 2013 State of the Nation address that CPGS weapons could undermine nuclear arms control agreements is one high-profile example. The previous year, both Antonov and the commander of Russia's Strategic Rocket Forces, Lt. Gen. Sergei Karakayev, had made similar points, albeit in less ear-catching terms.<sup>79</sup>

Putin's and Antonov's statements, along with many others, reference CPGS alongside ballistic missile defense. This is no coincidence. Moscow is particularly concerned that this combination could allow the United States to attempt a disarming first strike without crossing the nuclear threshold.<sup>80</sup> Officials have sometimes outlined this concern explicitly. In 2007, for example, Antonov, who was then Director of the Security and Disarmament Department at Russian Ministry of Foreign Affairs, stated in characteristically flamboyant terms that

We see a direct link between U.S. plans for global missile defense and the prompt global strike concept which means the ability to strike any point on the globe within an hour of the relevant decision. This concept, when combined with global missile defense, becomes a means of seeking to dominate the world politically and strategically. This is a rather serious factor which undermines the principles of mutual deterrence and mutual security and erodes the architecture of strategic stability.<sup>81</sup>

In fact, Russian concerns about conventional counterforce are now so acute that, according to Yevgeny Miasnikov, a Russian analyst who has written extensively on strategic, conventional weapons,

A number of [Russian] experts believe that [precision-guided weapons] pose a greater threat to the survivability of Russian [strategic nuclear forces] over the medium term than do ballistic missile defenses, since over this timeframe no technological breakthroughs are anticipated that could significantly improve the effectiveness of [ballistic missile defenses] against [intercontinental ballistic missiles], while at the same time the United States has already amassed a considerable counterforce capability for its [precision-guided weapons], which in the future will only grow.<sup>82</sup>

For the time being at least, Russian analysts who argue that precision-guided conventional weapons pose a greater threat than ballistic missile defense to Russia's nuclear forces appear to be in the minority. Indeed, Russian Deputy Foreign Minister Sergei Ryabkov stated explicitly in

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<sup>79</sup> Antonov, "Russia Forced to Develop Global Prompt Strike Weapons," 6; "Russia Plans Rail-Mounted Missiles to Counter U.S. Global Strike Program," RIA Novosti, December 18, 2013.

[http://en.ria.ru/military\\_news/20131218/185683711/Russia-Plans-Rail-Mounted-Missiles-to-Counter-US-Global-Strike.html](http://en.ria.ru/military_news/20131218/185683711/Russia-Plans-Rail-Mounted-Missiles-to-Counter-US-Global-Strike.html)

<sup>80</sup> For example, Mikhail Remizov, "Tsena Voprosa" [The Cost of the Matter], *Kommersant*, December 12, 2013: 8.

<http://kommersant.ru/doc/2365705>

<sup>81</sup> A. I. Antonov, remarks, NATO-Russia Council Meeting, [2007] (now available from

[http://web.archive.org/web/20080704102317/http://www.nato-russia-council.info/hm/EN/news\\_33.shtml](http://web.archive.org/web/20080704102317/http://www.nato-russia-council.info/hm/EN/news_33.shtml)).

<sup>82</sup> Miasnikov, "Precision-Guided Conventional Weapons," 432–3.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

December 2013 that ballistic missile defense remains “our first concern.”<sup>83</sup> However, if U.S. missile defenses continue to be developed more slowly than planned (as the cancellation of phase four of the European Phased Adaptive Approach typifies) and Washington moves ahead with a CPGS acquisition program, it seems possible that high-precision conventional weapons could move ahead of ballistic missile defense and to the very center of Russian concerns.

### ***Strategic, conventional weapons are more usable than nuclear weapons.***

The greater “usability” of conventional weapons compared to nuclear weapons is another important aspect of Russian concerns. It results in a twin fear: that the United States is less inhibited in using conventional weapons than nuclear weapons, *and* that a Russian nuclear response to a conventional strike would lack credibility. Russian Foreign Minister, Sergei Lavrov, for example, has argued that the development of “conventionally armed long-range missile systems will lead to a significant decrease in the ‘threshold’ for strategic missiles use.”<sup>84</sup> Meanwhile, Alexei Arbatov, an analyst and former Duma member, writes of an “unspoken assumption” among Russian analysts that “traditional nuclear deterrence may not be effective against conventional counterforce threats, since nuclear retaliation [by Russia]...would invite suicide by follow-on nuclear strikes [by the United States] and thus lacks credibility.”<sup>85</sup> Arbatov, it should be noted, roundly rejects this analysis himself—elsewhere he emphasizes his belief that a Russian nuclear response would be sufficiently credible to deter a U.S. conventional first strike<sup>86</sup>—but he argues that few of his colleagues are as sanguine.

Three further Russian concerns relate to hypersonic weapons specifically and not to the broader class of strategic, conventional weapons.

### ***The CPGS program is just too sophisticated to be about any state other than Russia.***

There is widespread disbelief in Russia that the development of long-range, conventional, hypersonic weapons by the United States is motivated by any state other than Russia. Arbatov, for example, argues that

Russians just cannot believe that such complicated and expensive systems are only meant to target terrorists, who can be dealt with by much cheaper and simpler weapons. The idea that America needs weapons with short flight times to destroy reckless state leaders and terrorists looks ridiculous to most Russian experts.<sup>87</sup>

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<sup>83</sup> Chernenko, “Takiye Sistemy Budut Nosit’ Isklyuchitel’no Opasnyy Kharakter.”

<sup>84</sup> Lavrov, “New START Treaty in the Global Security Matrix.”

<sup>85</sup> Arbatov, *Gambit or Endgame?*, 21.

<sup>86</sup> Alexei Arbatov, Vladimir Dvorkin, and Sergey Oznobishchev, *Non-Nuclear Factors of Nuclear Disarmament: Ballistic Missile Defense, High-Precision Conventional Weapons, Space Arms* (Moscow: IMEMO RAN, 2010), 34. [www.nuclearsecurityproject.org/uploads/publications/NON\\_NUCLEARFACTORSOFNUCLEARDISARMAMENT\\_062210.pdf](http://www.nuclearsecurityproject.org/uploads/publications/NON_NUCLEARFACTORSOFNUCLEARDISARMAMENT_062210.pdf)

<sup>87</sup> Arbatov, *Gambit or Endgame?*, 20. He goes on to add that “Ohio-class submarines [some of which have been converted to carry cruise missiles] are designed to stay on patrol for long periods of time and to remain undetectable even to sophisticated anti-submarine warfare systems, and heavy bombers are capable of penetrating advanced air defenses. Rogue states and terrorists possess neither anti-submarine warfare nor serious air-defense systems” (20-21).

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

A handful of official documents and statements add fuel to the fire of Russian concerns. Taken as a whole, official U.S. pronouncements indicate very little interest in using U.S. conventional weapons to hold Russian nuclear forces at risk—but there are exceptions. For example, while he was the commander of U.S. Strategic Command, Gen. James Cartwright did publicly advocate for the substitution of nuclear with conventional weapons to enable further reductions.<sup>88</sup> Cartwright's statements, and a few others from about the same time, still appear to contribute to a Russian perception that the United States wants to rely more heavily on conventional weapons in targeting Russia, its principle nuclear adversary.<sup>89</sup>

### *CPGS delivery systems might be re-armed with nuclear warheads.*

The possibility that the high-precision delivery systems being developed under the CPGS program might be re-armed with nuclear warheads is a worry that the author has heard in many conversations with Russian experts and officials. Although it has not been openly discussed as much as other concerns, Antonov has raised it publicly.<sup>90</sup> Importantly, it is distinct from the “classical” warhead ambiguity problem, which revolves around the difficulty of Russia's distinguishing conventional weapons from superficially similar nuclear ones. Rather, Moscow's worry here is that it might *not* be mistaken in identifying an incoming hypersonic weapon as nuclear-armed. There is a clear tension between this fear and the fear that the United States seeks strategic, conventional weapons because they are more usable than nuclear weapons.<sup>91</sup>

Russian concerns that nominally non-nuclear weapons might be converted to carry nuclear warheads are not unprecedented. In 2009, for example, Robert Gates, who was then the U.S. secretary of defense, said in describing Russian objections to American missile defense plans that “the Russians believed, despite our best efforts to dissuade them, that the ground-based interceptors in Poland could be fitted with nuclear weapons and become an offensive weapon.”<sup>92</sup>

### *Russia would have very little warning of a boost-glide attack.*

A final concern, raised by more technically inclined experts, is that early-warning radars would provide much less warning of a boost-glide attack than a ballistic missile attack. This characteristic of boost-glide weapons is presumably a matter of general concern, but has been cited by Arbatov as a particular threat to Russia's nuclear forces.<sup>93</sup> Once again, this is a new take

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<sup>88</sup> U.S. House of Representatives Armed Services Committee, *National Defense Authorization Act for Fiscal Year 2008 and Oversight of Previously Authorized Programs: Budget Request from the U.S. Strategic Command, Northern Command, Transportation Command, and Southern Command*, HASC no. 110-40, 110th Cong., 1st sess., March 21, 2007, 6. [www.gpo.gov/fdsys/pkg/CHRG-110hhrg37320/pdf/CHRG-110hhrg37320.pdf](http://www.gpo.gov/fdsys/pkg/CHRG-110hhrg37320/pdf/CHRG-110hhrg37320.pdf)

<sup>89</sup> For example, see the references in Miasnikov, “Precision-Guided Conventional Weapons.”

<sup>90</sup> Antonov, “Russia Forced to Develop Global Prompt Strike Weapons,” 6-7. This concern is also mentioned in passing in Alexei Arbatov, “New Global Strike Systems Create Serious Problems for Russia,” Carnegie Moscow Center, October 24, 2013. <http://carnegie.ru/2013/10/24/new-global-strike-systems-create-serious-problems-for-russia/gtpk>

<sup>91</sup> The author has heard both concerns raised in the same conversation.

<sup>92</sup> Office of the Assistant Secretary of Defense (Public Affairs), U.S. Department of Defense, transcript of briefing with Robert Gates and James Cartwright, September 17, 2009. [www.defense.gov/transcripts/transcript.aspx?transcriptid=4479](http://www.defense.gov/transcripts/transcript.aspx?transcriptid=4479)

<sup>93</sup> Arbatov, “New Global Strike Systems Create Serious Problems for Russia.”

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

on an old concern. During the Cold War, Moscow appeared to worry that forward-deployed nuclear-armed missiles, which could reach the Soviet Union much faster than Intercontinental Ballistic Missiles (ICBMs) based in the United States, might be used for “strategic decapitation”—attacking command and control, and possibly leadership, in order to prevent Soviet nuclear forces from being used during an ongoing American first strike. The United States’ deployment of Pershing II missiles in Europe in the 1980s sparked particular concern in this regard.<sup>94</sup>

### Russian Asymmetric Responses

Russian views on strategic, conventional weapons—hypersonic ones in particular—appear to be influencing its military doctrine and procurement policies. One important doctrinal development is the threat to respond with nuclear weapons to CPGS attacks against Russia. The most important articulation of this doctrine came in December 2013 when Rogozin publicly stated that the United States “may experiment with conventional weapons on strategic delivery platforms, but they must bear in mind, that if we are attacked, in certain circumstances we will of course respond with nuclear weapons.”<sup>95</sup> While this threat was unusually explicit—and notable for mentioning CPGS specifically—it appears to represent the exposition of an existing policy, rather than a new policy. In 2010, for example, Sergei Rogov, Director of the Institute for American and Canadian Studies, and retired generals Viktor Esin, Pavel Zolotarev, and Valeriy Yarynich argued that concern about strategic, conventional weapons was “one of the reasons for lowering the ‘nuclear threshold’ in the official Russian Military Doctrine.”<sup>96</sup> Some analysts and officials in Russia view tactical nuclear weapons as being particularly suitable for responding to an attack with strategic, conventional weapons.<sup>97</sup> Once again, though, there is a definite tension here: this time between the belief that a nuclear response to a conventional attack would lack credibility and the threat to do just that.

In terms of hardware, Russian officials have explained various aspects of Moscow’s ongoing military modernization as a direct response to CPGS. Two important foci of modernization—perhaps its two most important—are Russia’s nuclear forces, and its air and missile defenses. Indeed, these efforts were the only specific programs highlighted by Putin in a September 2014 speech (in which he also mentioned CPGS) delivered at a drafting session for the 2016-2025 State Armament Program.<sup>98</sup> After the meeting Rogozin went further and drew a direct link between CPGS and these programs, stating that “our response to the prompt global strike

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<sup>94</sup> Michael McGwire, *Military Objectives in Soviet Foreign Policy* (Washington, DC: Brookings Institution, 1987), 260-1. See also Office of the Assistant Secretary of Defense (Public Affairs), transcript of briefing with Robert Gates and James Cartwright.

<sup>95</sup> Quoted in “Russia Warns of Nuclear Response to U.S. Global Strike Program,” RIA Novosti, 11 December 2013. [http://en.ria.ru/military\\_news/20131211/185462951/Russia-Warns-of-Nuclear-Response-to-US-Global-Strike-Program.html](http://en.ria.ru/military_news/20131211/185462951/Russia-Warns-of-Nuclear-Response-to-US-Global-Strike-Program.html)

<sup>96</sup> Sergei M. Rogov, Viktor Esin, Pavel S. Zolotarev, and Valeriy Yarynich, “Sood’ba Stratyegichyeskih Vooroozhyenyi Poslye Pragi” [The Fate of Strategic Arms After Prague], *Nyezavisimoye Voyennoye Obzryeniye* [Independent Military Review], August 27, 2010. [http://nvo.ng.ru/concepts/2010-08-27/1\\_strategic.html](http://nvo.ng.ru/concepts/2010-08-27/1_strategic.html)

<sup>97</sup> Arbatov, Dvorkin, and Oznobishchev, *Non-Nuclear Factors of Nuclear Disarmament*, 35.

<sup>98</sup> Putin, remarks at meeting on “Drafting the 2016-2025 State Armament Programme.”

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

strategy is upgrading our strategic nuclear forces...and also developing air and space defense resources.”<sup>99</sup>

One notable aspect of Russia’s modernization of its nuclear forces is its decision to “develop a preliminary design” for a new rail-mobile ICBM. During the Cold War, Russia developed one such missile, the SS-24 (*Scalpel*), which was deployed from 1987 to 2005. The decision to revive this basing mode was announced in December 2013 by Karakayev, who directly connected it to the CPGS program and argued that a rail-mobile ICBM would offer advantages for survivability.<sup>100</sup>

Russia is also engaged in a large-scale effort to improve its air and missile defenses.<sup>101</sup> Its 2010 Military Doctrine identifies one of the main tasks of Russia’s military as ensuring “the air defense of the Russian Federation’s most important military facilities and readiness to rebuff strikes by means of air and space attack.”<sup>102</sup> Arbatov, Dvorkin, and the academic Sergei Oznobishchev argue that American strategic, conventional weapons are a major driver of this effort, noting that because

There are currently no orbital weapons, and there is no prospect that they will appear in the foreseeable future, the notion “means of air and space attack” apparently relates to conventionally armed cruise missiles and ballistic missiles, with high precision guidance provided by space information systems.<sup>103</sup>

## Russian Symmetric Responses

Given Putin’s belief that “high-precision long-range weapons...will become the means of achieving a decisive victory in conflicts,” it is hardly surprising that he has called for Russia to “design and adopt next-generation weapons and combat units, including high-precision weapons, whose capabilities...are close to those of nuclear deterrent forces.”<sup>104</sup> Much of Russia’s work in this area appears to be focused on subsonic cruise missiles, including a ground-launched system that the United States has stated is in violation of the 1987 Intermediate Nuclear Forces Treaty.<sup>105</sup> However, Russia is working on hypersonic systems, too. It has acknowledged its development of hypersonic cruise missiles, even if details of its program remain murky.<sup>106</sup> There

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<sup>99</sup> “Russia Announces Plans to Upgrade Nuclear, Air Defense Forces,” Agence France-Press, September 10, 2014. <http://www.defensenews.com/article/20140910/DEFREG01/309100040/Russia-Announces-Plans-Upgrade-Nuclear-Air-Defense-Forces>

<sup>100</sup> “Russia Plans Rail-Mounted Missiles to Counter U.S. Global Strike Program.”

<sup>101</sup> The State Armaments Program for 2011-2020 calls for the procurement of 56 divisions of S-400 air defense systems and 10 divisions of S-500 systems. Vladimir Shabanov, “Major Army Modernization Program to Cost Russia over 20 Trillion,” *Pravda*, March 1, 2011. [http://english.pravda.ru/business/finance/01-03-2011/117052-russian\\_army-0](http://english.pravda.ru/business/finance/01-03-2011/117052-russian_army-0)

<sup>102</sup> *The Military Doctrine of the Russian Federation*, para. 27.f.

<sup>103</sup> Arbatov, Dvorkin, and Oznobishchev, *Non-Nuclear Factors of Nuclear Disarmament*, 26.

<sup>104</sup> Putin, “Being Strong.”

<sup>105</sup> U.S. Department of State, *Adhere to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements*, July 2014, 8. <http://www.state.gov/documents/organization/230108.pdf>

<sup>106</sup> Acton, *Silver Bullet?*, 104-6.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

is also reasonably strong—but not completely conclusive—evidence that it is also engaged in the development of a conventional boost-glide system.

In the last two years, a series of senior Russian officials have made statements that indicate an interest in developing conventional boost-glide weapons and have hinted that such efforts are already underway—although none has said so unambiguously. In December 2012, Karakayev announced that Russia’s planned new “heavy” ICBM would provide “the capability of creating a strategic high-accuracy weapon system with a conventional payload with practically global range, if the U.S. does not pull back from its program for creating such missile systems.”<sup>107</sup> Four months later, in April 2013, Antonov stated (somewhat confusingly) that Russia had wanted to prohibit strategic, conventional arms but “taking into account the U.S. activity, Russia *is* forced to develop such arms *in future*.”<sup>108</sup> In December of that year, the well-connected Russian journalist Yelena Chernenko, writing with Ivan Safronov, claimed that Russia was developing hypersonic, precision-guided weapons of an unspecified type or types. As evidence they quoted Deputy Defense Minister Yuri Borisov as saying that “Americans may acquire these weapons at the turn of 2018. But by that time, we will be ready with our response.”<sup>109</sup> Finally, immediately after complaining about CPGS in his State of the Nation address in December 2013, Putin stated that

Russia will respond to all these challenges, both political and technological. We have all we need in order to do so. Our military doctrine and advanced weapons, weapons that are being and *will be deployed*, will unconditionally allow us to ensure the security of the Russian state.<sup>110</sup>

Taken alongside the other statements, it seems likely that the “advanced weapons” that “will be deployed” include conventional boost-glide systems. (It is possible that these statements might refer to a conventionally armed ballistic missile, but such a weapon would not have “practically global range.”)

Circumstantial evidence from negotiations over the New Strategic Arms Reduction Treaty (New START) in 2009 further supports this claim. Russia sought an outright ban on the emplacement of conventional warheads on ICBMs or sea-launched ballistic missiles (the United States and Russia eventually agreed to count such systems as nuclear armed). Surprisingly, however, Russia did *not* ask for the same provision to be applied to conventional boost-glide systems.<sup>111</sup> One

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<sup>107</sup> “Russia to Develop Precision Conventional ICBM Option,” RIA Novosti, December 14, 2012.

[http://en.rian.ru/military\\_news/20121214/178154441.html](http://en.rian.ru/military_news/20121214/178154441.html)

The potential for the new missile to carry a maneuvering warhead had been noted long before Karakayev’s announcement. See Pavel Podvig, “Would Russia Build a New MIRVed ICBM?” *Russian Strategic Nuclear Forces* (blog), December 20, 2010. [http://russianforces.org/blog/2010/12/would\\_russia\\_build\\_a\\_new\\_mirve.shtml](http://russianforces.org/blog/2010/12/would_russia_build_a_new_mirve.shtml)

<sup>108</sup> My Italics. This translation, provided by Yevgeny Miasnikov, is from the original Russian interview. Anatoly Antonov, “Rossiya Vynuzhdena Zanyat’sya Sozdaniyem Strategicheskogo Oruzhiya V Neyadernom Osnashchenii” [Russia Must Develop Non-Nuclear Strategic Arms], *Indeks Bezopasnosti* [Security Index] 19, no. 2 (2013): 16. <http://www.pircenter.org/media/content/files/11/13722618170.pdf>. The English edition of *Security Index* quotes Antonov as saying something slightly different, namely that “the United States pushed us, and we are forced to start such an arms race in the future.” See Antonov, “Russia Forced to Develop Global Prompt Strike Weapons.”

<sup>109</sup> Chernenko and Safronov, “Razgonka Vooruzheniy.”

<sup>110</sup> My italics. Putin, address to the Federal Assembly, 2013.

<sup>111</sup> This has been confirmed by U.S. officials involved in New START negotiations.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

possible interpretation is that, by 2009, Russia intended to create—or already had in place—a program to develop conventional boost-glide weapons and did not want them to be treaty accountable.

There is also considerable evidence that Russia is actively engaged in a program to develop some type of maneuverable reentry vehicle (MaRV)—although it is unclear if this program is exclusively focused on ensuring that nuclear warheads can penetrate ballistic missile defenses or whether it has been expanded to encompass the development of a long-range conventionally armed boost-glide system.<sup>112</sup> (MaRVs are any form of missile reentry vehicle capable of maneuvering; hypersonic gliders, which are a type of MaRV, are capable of significantly extending the missile's range by remaining aloft for long distances. The development of a MaRV with limited gliding capability would be a natural first step toward acquiring a long-range glider.)

Russian interest in boost-glide weapons has long historical roots. The Austrian aeronautical engineer Eugen Sänger first developed the concept prior to World War I. Following the war, Stalin reportedly became “infatuated” with the concept and tried (unsuccessfully) to “acquire” Sänger.<sup>113</sup> Whether the Soviet Union made any progress on boost-glide technology during the early Cold War is unknown. However, it is reported to have begun developing (or perhaps re-developing) less ambitious MaRV technology in the 1980s to deliver nuclear weapons out of concern that existing reentry vehicles might not be able to penetrate the highly effective defenses foreseen by President Ronald Reagan's “Star Wars” program.<sup>114</sup>

Russian efforts were revitalized at some point in the 1990s, apparently for similar purposes.<sup>115</sup> A test of a hypersonic MaRV, as part of a major strategic forces exercise in February 2004, was publicized by the Russian government and widely reported.<sup>116</sup> Reports about this test are, however, confusing and contradictory. Some claim that the reentry vehicle was launched by a solid-fueled SS-25 (*Topol*) missile;<sup>117</sup> others that a liquid-fueled SS-19 (*Stiletto*) was used.<sup>118</sup> Given subsequent developments outlined below, the use of an SS-19 seems more likely. The test

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<sup>112</sup> Russia has advertised its development of a MaRV designed to defeat *terminal* missile defenses. This is a distinct effort from the program discussed elsewhere in this section. Pavel Podvig, “MARV is Back,” *Russian Strategic Nuclear Forces* (blog), August 5, 2014. [http://russianforces.org/blog/2014/08/marv\\_is\\_back.shtml](http://russianforces.org/blog/2014/08/marv_is_back.shtml)

<sup>113</sup> Robert Godwin, introduction to *Dyna-Soar: Hypersonic Strategic Weapons System*, ed. Godwin (Burlington, ON: Apogee Books, 2003), 7.

<sup>114</sup> Nikolai Sokov, “Military Exercises in Russia: Naval Deterrence Failures Compensated by Strategic Rocket Success,” *CNS Research Story*, James Martin Center for Nonproliferation Studies, February 24, 2004. <http://cns.miis.edu/stories/040224.htm>

<sup>115</sup> Sokov, “Military Exercises in Russia;” Pavel Podvig, “Russian Hypersonic Vehicle—More Dots Added to Project 4202,” *Russian Strategic Nuclear Forces* (blog), August 26, 2014. [http://russianforces.org/blog/2014/08/russian\\_hypersonic\\_vehicle\\_-\\_m.shtml](http://russianforces.org/blog/2014/08/russian_hypersonic_vehicle_-_m.shtml)

<sup>116</sup> Sokov, “Military Exercises in Russia.” Some reports cited by Sokov describe the reentry vehicle essentially as a hypersonic cruise missile and not a MaRV. However, it seems extremely unlikely that a hypersonic cruise missile would be launched by a booster as powerful as an ICBM.

<sup>117</sup> Sokov, “Military Exercises in Russia.”

<sup>118</sup> Pavel Podvig, “Putin's Miracle Weapon Revisited,” *Russian Strategic Nuclear Forces* (blog), February 7, 2005. [http://russianforces.org/blog/2005/02/putins\\_miracle\\_weapon\\_revisite.shtml](http://russianforces.org/blog/2005/02/putins_miracle_weapon_revisite.shtml)

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

was initially reported as a success. However, in February 2005, the missile designer Yuri Solomonov claimed that the reentry vehicle burned up in the atmosphere.<sup>119</sup>

There are reports that this reentry vehicle was tested again in November 2005.<sup>120</sup> However, if the booster for Russia's MaRV is indeed the SS-19 then these reports were probably incorrect, since the November 2005 test involved either an SS-25 or SS-27 (*Topol-M*) missile.<sup>121</sup> Indeed, other descriptions of this test simply make a generic mention of penetration aids, which are designed to defeat missile defenses but could perhaps be assumed to be a MaRV in sloppy reporting.<sup>122</sup>

In 2007, Putin made a clear reference to Russian MaRV development when he was asked, at a press conference, about U.S. plans to deploy ballistic missile defenses in Europe. He first mentioned countermeasures on the nuclear-armed SS-27 before stating that Russia was developing "strategic weapons systems of a completely different type that will fly at hypersonic speed and will be able to change trajectory both in terms of altitude and direction, and missile defense systems will be powerless against them."<sup>123</sup> These comments are significant because they suggest that, at that time, Russia's MaRV program was still focused on ensuring that nuclear warheads could be delivered through ballistic missile defenses and not on the development of a conventionally armed boost-glide weapon.

Following these events, Moscow has been largely silent about this program. However, Pavel Podvig, an analyst who is widely recognized for his work on Russia's strategic forces, has recently pieced together information about the program's subsequent development from publicly available documents such as regulatory approvals.<sup>124</sup> This information suggests that, since 2004, a hypersonic MaRV has been tested on at least two further occasions—in December 2011 and September 2013. Both tests used an SS-19 as the booster. The September 2013 test appears to have failed; no information is available on the outcome of the December 2011 test.

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<sup>119</sup> Podvig, "Putin's Miracle Weapon Revisited." Solomonov is the General Designer of the Moscow Institute of Thermal Technology. His personal and organizational rivalry with NPO Mashinostroyeniya, which designed the SS-19, is well known.

<sup>120</sup> Nikolai Sokov, "The Future Shape of Russia's ICBM Force Clarified," *CNS Research Story*, James Martin Center for Nonproliferation Studies, November 9, 2005, <http://cns.miis.edu/stories/051109.htm>. Reports quoted by Sokov refer to the reentry vehicle as *Igla*. However, this name may be incorrect since *Igla* is a man-portable air defense system.

<sup>121</sup> Pavel Podvig, "Confusion About Topols," *Russian Strategic Nuclear Forces* (blog), November 2, 2005. [http://russianforces.org/blog/2005/11/confusion\\_about\\_topols.shtml](http://russianforces.org/blog/2005/11/confusion_about_topols.shtml)

<sup>122</sup> Pavel Podvig, "Test of Anti-Missile Defense Capabilities of Ballistic Missiles," *Russian Strategic Nuclear Forces* (blog), November 1, 2005. [http://russianforces.org/blog/2005/11/test\\_of\\_antimissile\\_defense\\_ca.shtml](http://russianforces.org/blog/2005/11/test_of_antimissile_defense_ca.shtml)

<sup>123</sup> President of Russia, transcript of press conference with Russian and foreign media, Moscow, February 1, 2007. [http://archive.kremlin.ru/eng/speeches/2007/02/01/1309\\_type82915type82917\\_117600.shtml](http://archive.kremlin.ru/eng/speeches/2007/02/01/1309_type82915type82917_117600.shtml)

<sup>124</sup> This paragraph and the next are drawn from Podvig, "Russian Hypersonic Vehicle—More Dots Added to Project 4202;" Pavel Podvig, "Some New Missile System to be Deployed in Dombarovskiy," *Russian Strategic Nuclear Forces* (blog), December 18, 2013. [http://russianforces.org/blog/2013/12/some\\_new\\_missile\\_system\\_to\\_be.shtml](http://russianforces.org/blog/2013/12/some_new_missile_system_to_be.shtml); Pavel Podvig, "Test of a 'Hypersonic Vehicle' in September Ended in Failure," *Russian Strategic Nuclear Forces* (blog), December 2, 2013. [http://russianforces.org/blog/2013/12/test\\_of\\_a\\_hypersonic\\_vehicle\\_i.shtml](http://russianforces.org/blog/2013/12/test_of_a_hypersonic_vehicle_i.shtml); Pavel Podvig, "Object 370, Project 4202 and Construction in Dombarovskiy," *Russian Strategic Nuclear Forces* (blog), February 6, 2013. [http://russianforces.org/blog/2013/02/object\\_370\\_project\\_4202\\_and\\_co.shtml](http://russianforces.org/blog/2013/02/object_370_project_4202_and_co.shtml); Pavel Podvig, "New Warhead Tested in a UR-100NUTTH/SS-19 Launch," *Russian Strategic Nuclear Forces* (blog), December 27, 2011. [http://russianforces.org/blog/2011/12/new\\_warhead\\_tested\\_in\\_a\\_ur-100.shtml](http://russianforces.org/blog/2011/12/new_warhead_tested_in_a_ur-100.shtml)

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

Podvig has also uncovered a program called Project 4202, which was created in about March 2009 and involves a number of entities including NPO Mashinostroyeniya, the bureau responsible for designing the SS-19. Project 4202 appears to involve the modification of a silo to accommodate an SS-19 missile modified to carry an object designated 15Yu71, which may be a MaRV. Podvig's evidence suggests that "production of the 15Yu71 (or at least some of its key components) will begin in 2015."<sup>125</sup>

Assuming that Podvig's description is broadly correct, important questions about the 15Yu71 remain, including its range and whether it is designed to deliver a conventional or nuclear warhead. Converting a MaRV designed to deliver a nuclear warhead—Russia's original goal—into one capable of delivering a conventional warhead might not be straightforward. In particular, it is unlikely that a reentry vehicle designed for a nuclear warhead would have the necessary accuracy for ensuring that a conventional warhead would be militarily effective. Moreover, if the objective is to design a boost-glide weapon with "practically global range" (to use Karakeyev's goal) then the reentry vehicle would need to generate much more aerodynamic lift than would be required if its purpose was only to defeat missile defenses. Thus, while Russian research into MaRVs to defeat ballistic missile defenses would be helpful in developing a conventional boost-glide weapon, extensive further research and development would be needed. Whether serious work in this direction has yet begun is unclear.

### Conclusion

For Moscow, the development of long-range, non-nuclear, hypersonic weapons represents a revolution in warfare that is profoundly threatening. In fact, many Russian officials and analysts appear to believe much more fervently in the Conventional Prompt Global Strike program's potentially transformative impact than even its most vociferous advocates in the United States. Precisely because American efforts are viewed as so threatening, it comes as no surprise that Russia is considering developing its own hypersonic boost-glide weapons. Given Putin's personal views on the potential military impact of these weapons, there is a good chance that Russian efforts enjoy his personal support and will eventually reach fruition. However, serious difficulties lie ahead. Russia's development of a maneuvering reentry capable of penetrating ballistic missile defenses (a less challenging goal than a conventional boost-glide weapon) has been slow and there is evidence that it has been hindered by test failures. Moreover, a research and development program into conventional boost-glide weapons (which may already be underway) is likely to take at least a decade and would be extremely expensive, and possibly unaffordable. It would, therefore, be wrong to assume that Russia's eventual acquisition of conventional boost-glide weapons is a done deal.

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<sup>125</sup> Podvig, "Russian Hypersonic Vehicle—More Dots Added to Project 4202."

## Boost-glide Weapons and U.S.-Chinese Strategic Stability

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Like the United States, China appears to be developing a variety of new hypersonic weapons systems, including a boost-glide weapon: a long-range strike system whose payload, a hypersonic glide vehicle, flies at Mach 5 or faster through the upper atmosphere. Both countries now seem to have initiated HGV test programs. American efforts in this arena are an expression of its long-term pursuit of a conventional prompt global strike capability, rather than a new nuclear delivery system. China's purposes are less evident. Nevertheless, if these two powers overcome the special technological challenges associated with boost-glide systems, the deployment of such systems can be expected to have implications for strategic stability.<sup>126</sup> These concerns ought to be at the forefront of any considered analysis of the merits of boost-glide arsenals, their scale and posture, and the need for measures to mitigate associated risks.<sup>127</sup>

Unfortunately, the United States and China currently lack a common perspective on the purposes and broader implications of these systems. Movement towards the deployment of boost-glide weapons by the United States may convince Chinese leaders to consider shifts in strategic posture, including a transition from keeping nuclear forces at low levels of alert during peacetime in favor of adopting launch-on-warning. Such a posture would introduce greater potential for miscalculation. China's own pursuit of comparable systems adds further complexity and uncertainty to the picture; if nuclear-armed, their stability implications could be modest; if conventionally armed, they could compound existing risks. A lack of confidence on the Chinese side about the type of payloads carried by HGVs deployed on the opposite side of the Pacific can be expected to have deleterious effects.

### Hypersonic Weapons Development in China

Relatively little is known about hypersonic weapons development programs in China, especially in comparison to publicly available information about the same category of activities in the United States. Perhaps the most concrete indication of the state of the art in China consists of reports of the construction of advanced wind tunnels associated with the China Academy of Sciences (CAS), which could potentially support the development of different hypersonic systems.<sup>128</sup> Observers in the United States have previously hypothesized a connection between Chinese hypersonic wind tunnels and the development of the maneuvering reentry vehicle

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\*Disclaimer: This paper represents the author's views and not necessarily those of SAIC or its clients.

<sup>126</sup> M. Elaine Bunn and Vincent A. Manzo, "Conventional Prompt Global Strike: Strategic Asset or Unusable Liability?" INSS Strategic Forum No. 263, February 2011; James M. Acton, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike* (Washington, DC: Carnegie Endowment for International Peace, 2013). On stability concerns, see especially 111-133.

<sup>127</sup> The Obama Administration's 2010 *Nuclear Posture Review Report* declares "reinforcing strategic stability" to be a major goal in its relations with both Russia and China. Department of Defense, *Nuclear Posture Review Report*, April 2010, 28-29.

<sup>128</sup> Office of the Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, 2014, 45.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

associated with an anti-ship ballistic missile (ASBM).<sup>129</sup> What other types of systems might be under development in China is unclear. In recent years, Chinese researchers have published a variety of research articles modeling aspects of a variety of hypersonic vehicles, apparently with the development of its own systems in mind.<sup>130</sup> Lately, news media accounts have also described two test-flights of an HGV.<sup>131</sup> The details of the system remain obscure. In response to news media coverage, China's Ministry of Defense so far has confined itself to stating, "Our planned scientific research tests conducted in our territory are normal. These tests are not targeted at any country and at any specific goals."<sup>132</sup>

In general, the Chinese defense establishment relies heavily on missiles, and is busily diversifying its arsenal. The Second Artillery Corps of the People's Liberation Army (PLA) controls a variety of land-based ballistic missiles, ranging from silo-based and mobile nuclear ICBMs for strategic deterrence against a great-power adversary to conventional theater systems for fighting wars, intimidating regional opponents, and keeping superior enemy forces at a distance. Supplementing this force, the PLA Navy (PLAN) appears to be on the verge of deploying nuclear-armed ballistic missile submarines.<sup>133</sup> American analysts have long suspected that the Second Artillery may also be the most likely branch of the PLA to receive control of China's direct-ascent anti-satellite (ASAT) weapons once they are deployed.<sup>134</sup> Both the Second Artillery and the PLAN are adopting a diverse family of cruise missiles of growing sophistication, providing them with greater abilities to counter maritime threats and overcome missile defenses.<sup>135</sup>

Where boost-glide systems would fit into this picture is unclear. Three broad possibilities are worth considering. One is primarily technological: if the United States and other advanced powers are investing in this technology, so, too must China, but what purpose it would ultimately serve remains to be fully defined. A second possibility is strategic in character, involving a nuclear-armed intercontinental force capable of under-flying midcourse ballistic missile defense (BMD), helping to ensure the ability to retaliate.<sup>136</sup>

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<sup>129</sup> Mark Stokes, "China's Evolving Conventional Strategic Strike Capability," Project 2049 Institute, 14 September 2009, 28.

<sup>130</sup> Lora Saalman, "Prompt Global Strike: China and the Spear," Asia-Pacific Center for Security Studies, April 2014, 11-16.

<sup>131</sup> Bill Gertz, "China Conducts First Test of New Ultra-High Speed Missile Vehicle," *Washington Free Beacon*, 13 January 2014; Bill Gertz, "China Secretly Conducts Second Flight Test Of New Ultra High-Speed Missile," *Washington Free Beacon*, 19 August 2014; James Acton, Catherine Dill, and Jeffrey Lewis, "Analyzing China's August 7, 2014 Hypersonic Glider Test," *Arms Control Wonk*, 3 September 2014.

<sup>132</sup> "China confirms hypersonic missile carrier test," *Reuters*, 15 January 2014.

<sup>133</sup> Office of the Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, 6-8.

<sup>134</sup> Evan S. Medeiros, "'Minding the Gap': Assessing the Trajectory of the PLA's Second Artillery," in Roy Kamphausen and Andrew Scobell, eds., *Right Sizing the People's Liberation Army: Exploring the Contours of China's Military* (Carlisle, PA: Strategic Studies Institute, 2007), 178. Academics affiliated with the Second Artillery have commented on aspects of China's hit-to-kill test program. See Kevin Pollpeter, "China's Second Ballistic Missile Defense Test: A Search for Strategic Stability," SITC Bulletin Analysis, February 2013, 2.

<sup>135</sup> Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, *A Low-Visibility Force Multiplier: Assessing China's Cruise Missile Ambitions* (Washington, DC: National Defense University Press, 2014).

<sup>136</sup> Saalman, "Prompt Global Strike: China and the Spear," 16.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

The third possibility is that China is following the United States in pursuing a specifically conventional intercontinental capability. So far, there is little indication of a role for strategic conventional capabilities in Chinese strategic thinking. The sole precedent may be the development of a Chinese conventional intermediate-range ballistic missile.<sup>137</sup> A precision-strike asset targeted against a key regional base would fit neatly into the “anti-access” strategy that American analysts ascribe to China. What role an intercontinental conventional capability might play is less apparent, although one American analyst has suggested that intermediate-range and intercontinental-range precision-strike capabilities together would offer China’s leaders “a flexible deterrent that could achieve strategic and operational effects against an enemy in a crisis.”<sup>138</sup> Regardless, China has long taken technologically advanced states as role models for its own military and technological pursuits, in terms of types of systems if not always in numbers.<sup>139</sup>

### U.S.-Chinese Strategic Dynamics

Some discussions of long-range conventional strike weapons, including boost-glide weapons, have tended to consider them in isolation: as presidential weapons, designed to be used anywhere on earth on a moment’s notice, and not necessarily in conjunction with any other forces.<sup>140</sup> From the perspective of strategic stability, we should instead consider these weapons as part of an interrelated set of systems. These systems interact; how each side develops and postures its forces may influence how the other side does so and, especially in times of tension, incentives may arise to employ them before the other side does. These dynamics are sometimes described respectively in terms of “arms racing” or “arms stability” and “crisis stability” or “first-strike stability.” The two concepts are distinct but potentially related: an anticipation of a crisis-stability problem might be a reason for a state to invest in new or expanded capabilities. The ensuing arms race deepens mutual mistrust and may contribute to the potential for conflict.

Typically, these concepts have been applied to the interactions of nuclear forces, but the development of BMD, ASAT, and long-range conventional strike weapons – from ASBMs to boost-glide weapons – is bringing about a more complex set of interactions, in which one system type is “entangled” with another. To the extent that American specialists have focused on these issues, crisis-stability concerns have been paramount. Fear of nuclear coercion in a crisis, it is believed, could entice Chinese leaders to opt for ASAT strikes against orbital sensors associated with the U.S. BMD architecture; U.S. leaders, anticipating this danger, might decide to employ boost-glide weapons preemptively against Chinese ASAT systems. Fear of conventional coercion could work similarly, with Chinese leaders contemplating ASBM employment against approaching U.S. carrier strike groups, and U.S. leaders, understanding this possibility, weighing boost-glide attacks on ground-based assets in China that would support the targeting of U.S. naval vessels. Other factors raise concerns about the potential for inadvertently threatening China’s confidence in its ability to conduct nuclear retaliation in the course of a conventional

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<sup>137</sup> Office of the Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2013*, 2013, 41.

<sup>138</sup> Stokes, “China’s Evolving Conventional Strategic Strike Capability,” i.

<sup>139</sup> For past examples of emulation in the conventional sphere, see Acton, *Silver Bullet*, 132-133.

<sup>140</sup> National Research Council, *U.S. Conventional Prompt Global Strike: Issues for 2008 and Beyond* (Washington, DC: The National Academies Press, 2008).

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

fight. These factors include China's impending decision to take nuclear weapons to sea and apparent overlaps between the command and control of China's nuclear and conventional forces.<sup>141</sup>

The dominant Chinese conception of the strategic stability problem, by contrast, appears to focus almost exclusively on the threat of multiple U.S. strategic systems to Chinese nuclear forces. Chinese discussions have often packaged U.S. CPGS with BMD and nuclear weapons, on the reasoning that BMD and CPGS could threaten China's ability to retaliate with nuclear weapons, exposing it to nuclear coercion ("compellence") in a crisis.<sup>142</sup> This conception owes a debt to American thinking: the 2001 Nuclear Posture Review packaged long-range conventional strike together with nuclear weapons and defenses as parts of a still larger "New Triad."<sup>143</sup> Although this formula is no longer used, the 2010 posture review contained language about "maintaining an effective nuclear umbrella while placing increased reliance on non-nuclear deterrence capabilities (e.g., missile defenses and conventional long-range missiles)."<sup>144</sup> This statement is at least consistent with the idea that these capabilities could work as an interrelated whole, although it does not specifically express it.

Regardless of the pedigree of the concept, Chinese defense specialists appear increasingly seized by a threat from U.S. conventional long-range strike systems against Chinese strategic nuclear forces. A comparison of how PLA documents have treated conventional threats to nuclear forces in recent years may illuminate this point. A substantial section of a lengthy textbook from 2004, *Science of Second Artillery Operations*, discusses defensive operations, anticipating that the PLA's conventional and nuclear missile forces are liable to come under attack from precision-guided weapons based on land or sea, airstrikes, airborne forces, air assault forces,<sup>145</sup> or special operations forces.<sup>146</sup> Recently, the focus of these concerns has shifted in the direction of strategic strike, with CPGS in the leading role. The most recent (2013) edition of *Science of Strategy*, a textbook on military strategy produced by the PLA's Academy of Military Sciences, is far less detailed in discussing missile operations and lacks this catalogue of threats and defensive operations. Nonetheless – and in distinction to the previous 2001 edition of the same publication – it makes room to describe the potential for the employment of CPGS weapons against Chinese nuclear missiles, noting that this event could expose the country to coercive nuclear threats, reinforced by BMD capabilities.<sup>147</sup>

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<sup>141</sup> Jeffrey Lewis, "Chinese Nuclear Posture and Force Modernization," *Nonproliferation Review* (2009) 16(2):197-209; Michael S. Chase, Andrew Erickson, and Christopher Yeaw, "Chinese Theater and Strategic Missile Force Modernization and its Implications for the United States," *Journal of Strategic Studies* (2009) 32(1):67-114; Joshua Pollack, "Emerging Strategic Dilemmas in U.S.-Chinese Relations," *Bulletin of the Atomic Scientists* (2009) 65(4):53-63. On Chinese ASATs or anti-access systems as targets for U.S. CPGS, see Acton, *Silver Bullet?*, 17-21.

<sup>142</sup> Lora Saalman, "China and the U.S. Nuclear Posture Review," Carnegie Endowment for International Peace, 22-26.

<sup>143</sup> Department of Defense, Special Briefing on the Nuclear Posture Review, 9 January 2002.

<sup>144</sup> *Nuclear Posture Review Report*, April 2010, 46.

<sup>145</sup> In U.S. Army terminology, "airborne assault" refers to the employment of paratroops, while "air assault" refers to the employment of troops carried by helicopter.

<sup>146</sup> Yu Jixun, ed., *Dier Paobing Zhanyi Xue* [Science of Second Artillery Operations] (Beijing: PLA Press, 2004), 355-372.

<sup>147</sup> Shou Xiaosong, ed., *Zhanlue Xue* [Science of Strategy] (Beijing: Military Science Press, 2013), 171. The author thanks Michael Chase for pointing out this reference.

### Pressures on Chinese Nuclear Posture

If Chinese defense planners have come to regard this emerging “complex counterforce” threat as sufficiently serious, it could influence both how Chinese leaders act in a crisis and how they choose to posture their strategic forces over the long term. All available information, including the *Science of Second Artillery Operations*, indicates that the Second Artillery’s current expectation is to ride out an attack, even in the unlikely event of a nuclear strike. According to the Department of Defense, the Second Artillery has built and maintains an extensive network of underground facilities (UGFs):

Given China’s nuclear policy of ‘no first use’ and until recently its limited ballistic missile early warning capability, Beijing had assumed it might have to absorb an initial nuclear blow prior to engaging in ‘nuclear counterattack.’ Nuclear survivability was particularly critical given China’s relatively small number of nuclear weapons and the development by potential adversaries of modern, precision munitions. In recent years, advanced construction design has allowed militaries to go deeper underground to complicate adversarial targeting.<sup>148</sup>

Nevertheless, a sufficiently robust precision-strike capability, supported by BMD, might shake the confidence of PLA leaders in these arrangements under certain circumstances. Previous study of this subject has reached more sanguine conclusions, but may be based on a misunderstanding of Chinese nuclear posture. A 2011 analysis by a Chinese civilian academic researcher concludes that while other forces are potentially vulnerable to conventional counterforce, the mobile nuclear missiles of the Second Artillery are effectively immune. These assets are presumed either to be hidden in UGFs or kept dispersed and camouflaged above ground.<sup>149</sup>

In fact, it appears that the Second Artillery keeps its mobile missile units in recognizable, above-ground garages under peacetime conditions. An open-source research project has identified what appear to be all the main bases of Second Artillery mobile nuclear missile brigades.<sup>150</sup> Reviewing these sites in Google Earth, along with other recent commercial satellite imagery, shows structures that open-source analysis has identified as missile garages. No obvious UGFs can be observed at these sites.<sup>151</sup> Furthermore, it appears that most Chinese nuclear warheads are

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<sup>148</sup> Office of the Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2011*, 36. The latest version of the report carries this observation well beyond the Second Artillery, stating, “China maintains a technologically advanced underground facility (UGF) program protecting all aspects of its military forces, including command and control, logistics, and missile and naval forces. Given China’s NFU [no first use] nuclear policy, China has assumed it might have to absorb an initial nuclear blow while ensuring leadership and strategic assets survive.” *Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2014*, 29.

<sup>149</sup> Tong Zhao, “Conventional Counterforce Strike: An Option for Damage Limitation in Conflicts with Nuclear-Armed Adversaries?” *Science & Global Security* (2011), 19:195-222.

<sup>150</sup> Tamara Patton, Pavel Podvig, and Phillip Schell, *A New START Model for Transparency in Nuclear Disarmament: Individual Country Reports* (New York and Geneva: UNIDIR, 2013), 3-16.

<sup>151</sup> For Google Earth placemarks, see <http://nuclearforces.org/kmz/ModelNewSTARTData1Sep2012.kmz>. For other commercial imagery and analysis, see Hans Kristensen, “China’s Nuclear Forces and Potential Vulnerabilities: Potential Implications for Posture and Strategy,” *Federation of American Scientists*, September 24, 2012, 7, 10.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

stored at an underground central depot during peacetime, rather than mated to missiles.<sup>152</sup> In peacetime, therefore, mobile nuclear missiles might be found unarmed in identifiable, exposed facilities. As explained in China's 2008 Defense White Paper, "In peacetime the nuclear missile weapons of the Second Artillery Force are not aimed at any country. But if China comes under a nuclear threat, the nuclear missile force of the Second Artillery Force will go into a state of alert, and get ready for a nuclear counterattack to deter the enemy from using nuclear weapons against China."<sup>153</sup>

This statement offers a highly simplified rendering of what has been described elsewhere as a four-stage "ladder" of alerts.<sup>154</sup> It also passes over the closely related issue of missile maneuvers. A section of *Science of Second Artillery Operations* is devoted to operational maneuvers; at progressively higher states of alert, mobile missiles relocate from main bases to launch sites. The text also notes in passing the use of "standby positions" short of actual launch positions.<sup>155</sup> A small technical literature on mobile missile operations identified by a Chinese scholar similarly envisions a three-level system of operations involving "main sites," "forward sites," and "launch sites." Mobile missile units are routinely located at main sites. Under higher alert status, the missile units would receive orders to disperse to the forward sites. When ordered to launch, they would move a second time, to actual launch sites.<sup>156</sup> Protection and camouflage presumably come into play in the context of these movements away from the publicly recognized "main sites."

The reasons for maintaining vulnerable, recognizable, nuclear missile facilities might seem elusive to observers accustomed to the idea of a steady "day-to-day alert" in a survivable posture, but an explanation is available. As noted in the 2008 Defense White Paper, cited above, nuclear alerts are designed to deter the adversary during a crisis. These "counter-nuclear coercion" practices, which might be compared to the idea of "nuclear signaling," are described at length in the *Science of Second Artillery Operations*. The text holds that visible missile activity of ambiguous purpose – or, *in extremis*, of bluntly stated purpose – will give an adversary serious pause.<sup>157</sup>

### Potential Chinese Responses

The merits of alerting as a counter-nuclear coercion measure are open to question. According to one official American explanation of U.S. nuclear posture, "the generation of nuclear forces

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<sup>152</sup> Mark A. Stokes, "China's Nuclear Warhead Storage and Handling System," Project 2049 Institute, March 12, 2010.

<sup>153</sup> Information Office of the State Council of the People's Republic of China, *China's National Defense in 2008*, 20 January 2009.

<sup>154</sup> John Wilson Lewis and Xue Litai, *Imagined Enemies: China Prepares for Uncertain War* (Stanford: Stanford University Press, 2006), 202-205.

<sup>155</sup> Yu, ed., *Dier Paobing Zhanyi Xue*, 382-388. For "standby positions," see 385.

<sup>156</sup> Xie Tao, Wang Minle, Zhong Jianqiang, and Fang Qin, "Changgui Daodan Zhendi Peizhi Youhua Yanjiu" [Research on Optimal Deployment of Conventional Missile Positions], *Xitong Fangzhen Xuebao*, (March 2009), 21(6):1535-1537. Wang Minle and Gao Xiaoguang, "Zhanlue Daodan Jidong Zhendi Bushu Youhua Yanjiu Sheji" [Optimal Design of Deployment of Strategic Missile Mobile Positions], *Xitong Gongcheng Lilun Yu Shijian* (1999), 10:94-98, both as cited in Wu Riqiang, "Sino-U.S. Inadvertent Escalation," Program on Strategic Stability Evaluation (POSSE), n.d.

<sup>157</sup> Yu, ed., *Dier Paobing Zhanyi Xue*, 270-295.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

during a crisis, when none had been on alert, could cause an already tense situation to become unstable.”<sup>158</sup> But some of the alternatives that Chinese leaders may be contemplating in response to the prospect of conventional boost-glide deployments do not necessarily offer a net improvement from a crisis-stability perspective. Potential options could include the expansion of China’s nuclear arsenal, which is estimated to be an order of magnitude smaller than that of the United States<sup>159</sup>; planning for earlier missile deployments in a crisis than would otherwise be the case; or a decision (in “American” fashion) to keep at least a fraction of the force on higher alert during peacetime. Some combination of these three options is also possible. The advantages and drawbacks of each option can be briefly identified.

First, some enlargement of the nuclear force is already underway, but China’s leaders appear determined, as a matter of national strategic outlook, to maintain a relatively small arsenal and not to engage in a nuclear arms race, regardless of other considerations.<sup>160</sup> Incremental changes to operational practices appear more palatable.

Earlier dispersal is one such possibility. The discussion of the timing of maneuvers in *Science of Second Artillery Operations* does indicate concern about the possibility of sending missiles into the field either too early or too late.<sup>161</sup> It could be inferred that changes in the threat environment would lead to a change in PLA leaders’ calculations about the balance between these risks. Yet a “tilt” to earlier deployments in a crisis, effectively embracing a deeper reliance on “counter-nuclear coercion” operations, could be self-defeating. An early resort to missile maneuvers would shrink any opportunity for preemption, but could also intensify a crisis that otherwise might subside.

Under the circumstances, pursuing a transition from “counter-nuclear coercion” to a “day-to-day alert” status would presumably provide greater stability. Here, however, the small scale of the Chinese arsenal introduces a complication. The combination of conventional, nuclear, and BMD threats to China’s retaliatory capability could lead to cases in which the surviving fraction of PLA nuclear forces might not necessarily be expected to overwhelm BMD systems.

One answer to this risk would be to take additional measures to ensure the ability to retaliate. The PLAN could keep at least one ballistic missile submarine on patrol at all times, while the Second Artillery could adopt a launch-on-warning (LOW) posture, allowing it to perform its nuclear counterstrike before the adversary’s first strike arrives. This approach would maximize the PLA’s chances of overwhelming an opponent’s BMD. There are reasons to believe such a transition may be underway. First, the scale of the PLAN’s ballistic missile submarine deployments, which DOD expects to reach up to five hulls in the current class, suggests an

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<sup>158</sup> “Text of Nov. 28 E-mail from Strategic Command responding to ACT’s questions on the alert status of U.S. nuclear weapons,” *Arms Control Today*, November 2007.

<sup>159</sup> Credible open-source estimates of the size of China’s nuclear stockpile range from about 170 (Zhang) to about 250 (Kristensen and Norris). See Hui Zhang, “China’s Nuclear Weapons Modernization: Intentions, Drivers, and Trends,” Project on Managing the Atom, Harvard University, 15 July 2012; Hans M. Kristensen and Robert S. Norris, “Chinese Nuclear Forces, 2013,” *Bulletin of the Atomic Scientists*, 2013.

<sup>160</sup> Zhang, “China’s Nuclear Weapons Modernization”; Kristensen and Norris, “Chinese Nuclear Forces, 2013.”

<sup>161</sup> Yu, ed., *Dier Paobing Zhanyi Xue*, 382-388.

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

interest in continuous patrolling.<sup>162</sup> Second, the 2013 edition of *Science of Strategy* specifically identifies LOW as a viable option for PLA nuclear forces, judging it to be consistent with China's longstanding NFU policy.<sup>163</sup>

A shift to continuous patrolling of submarines and LOW for land-based missiles cannot happen instantaneously, as these elements of posture would require advanced command-and-control and early-warning systems. They would also require a new level of comfort with routinely deploying nuclear warheads mated to missiles. But if these changes should come to fruition, they would appear to detract from crisis stability, not to enhance it. In particular, PLA nuclear forces poised to launch would be subject to the same problems of false warning that have occurred elsewhere, particularly in the Soviet/Russian system.<sup>164</sup>

Chinese strategic forces would also be subject to the potential for misconstruing conventional attack as nuclear attack, sometimes called "warhead ambiguity." Even with the ability to distinguish ballistic missiles from boost-glide missiles, the PLA would not know what payloads attacking U.S. missiles carried. It might not even be possible to rely on Russian assurances about payloads, as the United States holds that boost-glide missiles would fall outside the definition of ballistic missiles in the New START Treaty and would therefore not be subject to any of its provisions, including Russian inspections.<sup>165</sup>

### Implications and Uncertainties

The pressures that U.S. boost-glide deployments would place on the Chinese strategic posture, in conjunction with other force types and self-imposed constraints on the scale and use of China's nuclear arsenal, are potentially significant, with deleterious effects on crisis stability.

China's own apparent decision to pursue boost-glide systems adds a layer of complexity and uncertainty to the problem. If these systems simply come to represent a new nuclear delivery mode for the PLA's Second Artillery, designed to complement ballistic missiles by under-flying BMD—and if the United States could be confident about this point—they could contribute marginally to strategic stability.

If some or all PLA boost-glide weapons are conventionally armed, or if the United States is uncertain about their payloads, they would have the opposite effect. A substantial intercontinental precision-strike arsenal in an all-purpose war fighting and deterrence role would present the United States with a new dilemma: China's vast lead in UGFs would offer it an

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<sup>162</sup> *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, 7.

<sup>163</sup> Shou, ed., *Zhanlue Xue*, 175.

<sup>164</sup> Bruce G. Blair, *The Logic of Accidental Nuclear War* (Washington, DC: Brookings Institution Press, 1993), 168-218.

<sup>165</sup> According to the Department of State, the U.S. side asserted this viewpoint during the negotiation of the New START Treaty. This perspective was later enshrined as an "understanding" in the Senate's resolution of ratification. See Bureau of Arms Control, Verification, and Compliance, "Article-By-Article Analysis of New START Treaty Documents," 5 May 2010, Main Treaty Text, Art. V, Para. 2; Bureau of Arms Control, Verification, and Compliance, "New START Treaty: Resolution Of Advice And Consent To Ratification," (b)(3).

## Hyper-glide Delivery Systems and the Implications for Strategic Stability and Arms Reductions

asymmetric advantage in a crisis or conflict. Even a limited number of boost-glide assets might be well-suited to strike ground-based radars associated with the U.S. BMD system. This type of capability would compound the problems of operational entanglement and crisis stability that the introduction of BMD, ASAT, and ASBM capabilities has already brought to the relationship.

Taken together with these other developments, boost-glide development on both sides of the Pacific could be seen as just one feature of an ongoing multi-pronged qualitative arms race. The pursuit and introduction of new strategic military technologies, free of limitations or transparency measures, is creating new operational realities, but not a common understanding of their nature or extent. Restraint in the deployment of novel weapons would be helpful, but difficult to achieve in the face of mutual mistrust and the lack of an established arms-control relationship. Calls for new confidence-building measures and expanded mutual transparency to ease these concerns and manage risks have already been voiced.<sup>166</sup> Continued testing of HGVs in the United States and China offers another reason to listen.

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<sup>166</sup> David C. Gompert and Phillip C. Saunders, *The Paradox of Power: Sino-American Strategic Restraint in an Age of Vulnerability* (Washington, DC: National Defense University Press, 2011); Lewis A. Dunn, ed., “Building Toward a Stable and Cooperative Long-Term U.S.-China Strategic Relationship,” Center for Strategic and International Studies, 31 December 2012.

## Appendix A: Workshop Agenda

*Hyper-glide and Hypersonic Cruise Missile Proliferation:  
The Implications for U.S. Security and Strategic Stability*

July 10, 2014

8:45am – 4:45pm

James Martin Center for Nonproliferation Studies

1400 K Street NW

Suite 1225

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|---------------|---|
| 8:45          | Welcome and Introduction<br>Jon Wolfsthal and James Acton   |
| 9:00 – 9:30   | What are Hyper-glide and Hypersonic Cruise Missiles and the Status of U.S., Russian and Chinese systems<br>James Acton – Carnegie Endowment for International Peace |
| 9:30 – 10:30  | New Systems and U.S. –Russian Deterrence and Strategic Stability<br>Hon. James Miller   |
| 10:30 – 11:30 | New Systems and U.S.-Chinese Deterrence and Strategic Stability<br>Joshua Pollack - SAIC  |
| 11:45 – 12:45 | Impact of Hyper-glide and Hypersonic Cruise Missile on Offense/Defense Interactions?<br>Dean Wilkening - LLNL   |
| 12:45 – 2:00  | Lunch and Keynote<br>General James Cartwright (Ret, USMC)   |
| 2:00 – 3:00   | Are We Repeating History, and Is That a Bad Thing?<br>Hon. Walter Slocombe  |
| 3:00 – 4:30   | Hyperglide and the future of arms control, transparency and nuclear reductions?<br>Steven Fetter - University of Maryland<br>Jon Wolfsthal - CNS                    |
| 4:30-4:45     | Conclusion and Wrap-Up  |

## Appendix B: Participants

James Acton	Carnegie Endowment for International Peace
Steve Andreasen	Nuclear Threat Initiative
Mike Bennett	Congressional Budget Office
Paul Bernstein	National Defense University
Joseph Cirinione	Ploughshares Fund
Elbridge Colby	Center for New American Security
Steve Fetter	University of Maryland
Richard "Chip" Hartman	Department of State
Paul Hommert	Sandia National Laboratories
Martin Hrivnak	Department of Defense
Ronald Lehman	Lawrence Livermore National Laboratory
Vince Manzo	Department of Defense
James Miller	
David Mosher	Congressional Budget Office
Steve Pifer	Brookings Institution
Josh Pollack	SAIC
Miles Pomper	Center for Nonproliferation Studies
Russel Rumbaugh	Stimson Center
Walt Slocombe	Atlantic Council
Leonard Spector	Center for Nonproliferation Studies
Richard Speier	Consultant
Sharon Squassoni	Center for Strategic and International Studies
Mark Stokes	Project 2049 Institute
Bob Vince	Lawrence Livermore National Laboratory
Drew Walter	Professional Staff Member, House Armed Services Committee
Dean Wilkening	Lawrence Livermore National Laboratory
Jon Wolfsthal	Center for Nonproliferation Studies
Amy Woolf	Congressional Research Service