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DEBATING CONVENTIONAL PROMPT GLOBAL STRIKE

JAMES M. ACTON | OCTOBER 3, 2013

For more than a decade, the U.S. Department of Defense has sought non-nuclear weapons that could hit distant targets "within minutes or hours." Research and development efforts into this Conventional Prompt Global Strike (CPGS) technology are making progress, and the Pentagon is expected to make a decision about whether to acquire these weapons during President Barack Obama's second term in office.

The Obama administration has indicated that CPGS weapons might have a role to play in combatting some of the foremost security challenges facing the United States, including the proliferation of advanced defensive systems, antisatellite (ASAT) weapons, and nuclear weapons. However, the Pentagon has not actually made any decisions about the doctrine governing the possible use of CPGS. In fact, U.S. officials generally do not distinguish between potential missions, preferring instead to talk generally about the need to hold distant, time-critical, highly defended, fleeting targets at risk.

Any CPGS acquisition decision should be preceded by an in-depth and detailed debate about the costs, risks, and benefits of all potential CPGS alternatives. Their military utility is a natural starting point for such a debate. However, without a clear picture of the missions for which these weapons might be acquired, there is no yardstick against which to judge their effectiveness. To complicate matters further, different CPGS technologies have different strengths and weaknesses. Their effectiveness in any scenario would be highly dependent on that scenario: the mission, the adversary, and the countermeasures that adversary has adopted.

While a fluid security environment forces the Pentagon to plan to do more, fiscal austerity forces it to plan on having less. Cost considerations cannot be ignored. Developing operational CPGS weapons would probably cost a few billion dollars (depending on the technology). That would require expenditures to ramp up significantly from current levels (as shown in figure 1). Compared to the weapons themselves, the capabilities that would be needed to support certain CPGS missions—surveillance systems in particular—could be much more expensive. Yet these enabling capabilities have attracted insufficient attention, as has the question of whether there are alternatives to long-range prompt-strike weapons, such as stealth technology, that might prove more cost effective.

Also missing from the debate is an in-depth examination of the full range of international ramifications of CPGS, including both benefits—most notably enhanced deterrence—and risks. To date, U.S. officials and Congress have concentrated on the risk that another state might incorrectly identify a CPGS weapon as a nuclear weapon and initiate a nuclear response. This almost-singular focus has unfortunately obscured other important risks and benefits.

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Assessing the CPGS program requires a comprehensive debate among the full range of relevant actors in the United States: the executive branch, including the Pentagon and the State Department; the military; Congress; and the American public. It would serve U.S. interests to engage certain foreign actors as well—including U.S. allies, Russia, and China—at an early stage. It may still be too soon to make a decision about whether a CPGS system should be acquired at all, but it is past time to start debating the many unanswered questions.

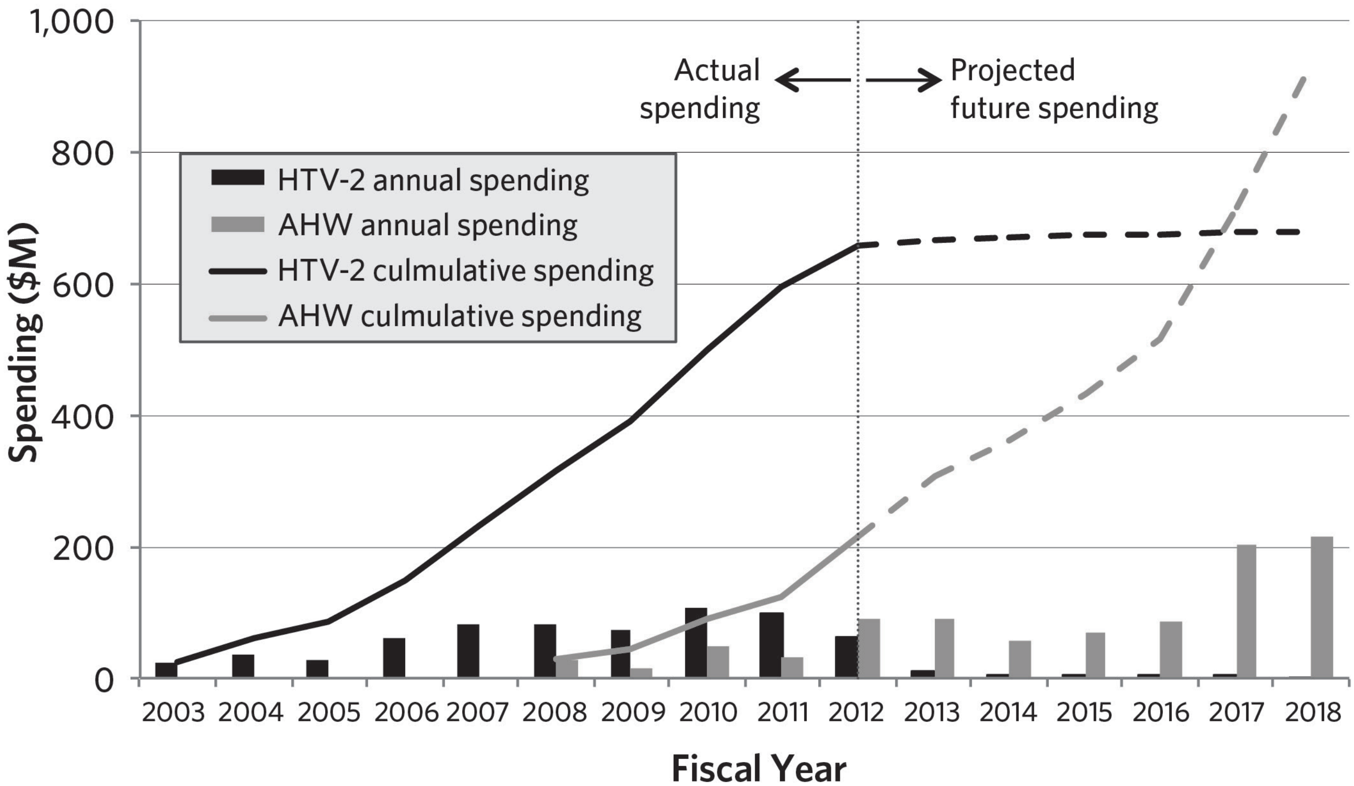
DIFFERENT MISSIONS, DIFFERENT REQUIREMENTS

The goals of the CPGS program are ill defined. Its purpose is often stated to be the development of high-precision conventional weapons capable of reaching targets anywhere on earth within an hour. Not only is this mantra an increasingly poor description of the technology actually being explored—the program's focus is now on weapons without global ranges—but it also does not speak to any specific military role for CPGS.

It appears that four military applications for CPGS are under consideration:

- *Countering emerging nuclear threats:* denying a new proliferator—notably North Korea or, in the future, a nuclear-armed Iran—the ability to employ its nuclear arsenal
- *Striking ASAT weapons:* destroying or disabling an adversary's antisatellite capabilities, particularly China's
- *Defense suppression:* countering China's and other states' anti-access/area-denial capabilities that threaten U.S. freedom of movement into and within combat zones
- *Counterterrorism:* killing high-value terrorists and disrupting terrorist operations

Figure 1. **Expenditure for CPGS Candidate Technologies**



Note: Annual and cumulative expenditure for two CPGS technologies, the Hypersonic Technology Vehicle-2 and the Advanced Hypersonic Weapon. See figure 2 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/2013/09/03/silver-bullet-asking-right-questions-about-conventional-prompt-global-strike/gkmp.

Each of these missions has quite different weapon requirements—a point that tends to be lost in abstract discussions of the potential military utility of CPGS weapons. These requirements differ according to a number of factors:

- The need for *promptness*—a short time between the decision to use a weapon and its reaching the target
- The need for *tactical surprise*—ensuring that an adversary has too little warning of an incoming strike to take effective countermeasures
- The required *range* of the weapon
- The type and effectiveness of *defenses*
- The *target's characteristics*, including whether it is mobile or buried

To attack Chinese antisatellite capabilities preemptively, for example, CPGS weapons would have to be able to penetrate robust defenses and could need ranges of a few thousand kilometers or more (depending on their basing mode). Tactical surprise would be critical to mission success. Promptness, however, would probably not be essential because the conflict would almost certainly have been preceded by a prolonged crisis, making it essentially irrelevant whether weapons took one hour or ten hours to reach their targets. By contrast, if North Korea used nuclear weapons and the United States sought to prevent further attacks, promptness could be critical, but the distances involved would generally be shorter and the defenses would be much weaker than in the case of attacks on China.

To develop weapons that are capable of getting the job done, distinctions in mission requirements must be recognized. The U.S. Department of Defense should, therefore, adopt a scenario-based approach to CPGS planning, if it is not already doing so. Before funding the acquisition of any CPGS system, Congress should require an unclassified statement from the Department of Defense on the potential missions for which CPGS might be acquired.

TECHNOLOGIES IN PLAY

The Pentagon's preferred approach to prompt long-range strike is to use a rocket to propel a reentry vehicle to many times the speed of sound and for the weapon to then glide in the upper atmosphere to the target. In theory, such hypersonic boost-glide weapons could enable global reach. In practice, the development of a global-range glider, the Hypersonic Technology Vehicle-2, has proceeded more slowly than expected. As a result, virtually all research and development funds are now focused on a less ambitious concept that has been tested successfully, the Advanced Hypersonic Weapon. This option could be land- or sea-based, would have a range of about 8,000 km (5,000 mi.), and could be ready for use at some point in the 2020s.

The Obama administration has also indicated an interest in developing a new Sea-Launched Intermediate-Range Ballistic Missile, which could be used to launch the Advanced Hypersonic Weapon. Alternatively, it could be configured as a terminally guided ballistic missile (one that can steer through the atmosphere toward its aim point but is not capable of significant gliding) with a range of perhaps 3,500 km (2,200 mi.) by equipping it with a steerable reentry vehicle that would follow a standard ballistic trajectory until reentering the atmosphere.

Compared to any of the other options, a terminally guided Sea-Launched Intermediate-Range Ballistic Missile could be developed more quickly, more cheaply, and with less technical risk (that is, it would be more likely to meet project goals on time and on budget). However, it probably could not be deployed any sooner because the class of submarine on which it would be based will not be available until the mid-2020s, if at all.

The U.S Air Force is also researching long-range hypersonic cruise missiles that could plausibly be used for certain missions requiring prompt long-range strike. This research is bureaucratically separate from the CPGS program. The missiles being developed would probably have ranges of less than 1,500 km (930 mi.) and could not be operational before the middle of the next decade. More technologies could eventually enter the fray because the Obama administration has promised to allow a competitive acquisition process, thus opening the door to other concepts suggested by industry.

With this range of options, Congress should compare the costs and risks of all the candidate technologies. A first step would be to hold dedicated hearings on the CPGS program. One question Congress should explore is whether research and development funding is spread among too many projects.

Most importantly, if long-range hypersonic cruise missiles do not have a military rationale that is distinct from CPGS, as appears to be the case, the two programs should compete directly for funding.

MILITARY STRENGTHS AND WEAKNESSES

These competing CPGS concepts are not simply alternative ways of achieving the same goals. All of them have strengths and weaknesses; none is the "best" in any absolute sense.

The military utility of all CPGS technologies could be significantly affected by the countermeasures that potential adversaries might adopt over the next few decades. For instance, *early-warning systems* that are capable of detecting incoming CPGS weapons could provide an adversary with enough warning time to foil the attack. Highly sophisticated satellite-based early-warning systems could provide a useful margin of tactical warning against most—if not all—CPGS weapons. Somewhat less advanced land-based early-warning radars would generally be ineffective against boost-glide weapons, but they might be effective against terminally guided ballistic missiles or hypersonic cruise missiles.

Adversaries could also employ advanced *air and missile defenses* to try to protect exactly the kind of high-value targets that CPGS might threaten. Hypersonic cruise missiles would be most vulnerable to these defenses, while terminally guided ballistic missiles would probably be the most survivable. That said, unless they were capable of executing "high-g" evasive maneuvers to dodge interceptors during their final approach to a target, all CPGS weapons could be threatened by advanced interceptors.

CPGS weapons armed with penetrating warheads could probably extend the depth at which the United States could hold buried targets at risk without nuclear weapons. Yet, air and missile defenses around buried targets would probably be quite effective. CPGS weapons would have to slow down to the optimum speed for delivering penetrating warheads capable of reaching underground targets, reducing the difficulty of intercepting them.

GPS denial—that is, interfering with the ability of CPGS weapons to receive the Global Positioning System (GPS) signals on which their navigation systems would probably rely—could also present a challenge. All potential CPGS candidates would be vulnerable to GPS denial. How serious this vulnerability would be depends on the technical feasibility of equipping CPGS weapons with backup guidance systems.

Range also has important implications for the military effectiveness of CPGS weapons. The combination of geography and defenses that contributes to a state's strategic depth dictates how close to their targets U.S. platforms can operate and imposes a minimum range requirement on weapons. Relatively short-range prompt weapons, including hypersonic cruise missiles, would be sufficient against states that have little strategic depth, such as North Korea. Longer-range ballistic or boost-glide weapons would be needed to hit targets deep within states with greater strategic depth, such as China.

Longer ranges, however, can have certain disadvantages. Basing weapons further from the target tends to reduce promptness and increase warning times. Thus, long-range boost-glide missiles might prove less effective than shorter-range weapons operating from just outside an adversary's "threat ring." Moreover, long-range weapons based on the Hypersonic Technology Vehicle-2 and possibly also the Advanced Hypersonic Weapon would be land-based and immovable. By contrast, sea- or air-based CPGS weapons would be mobile and could be deployed in a way that was visible to adversaries, enabling a president to use them to signal American resolve in a crisis.

Then there are the non-prompt alternatives to CPGS. A thorough comparison of these technologies to the prompt options will be critical in deciding whether to acquire CPGS weapons at all. Stealth is the principal competitor to speed in many circumstances. Stealthy weapons may be able to penetrate advanced defenses and also evade early-warning systems. For missions requiring promptness, forward basing can compensate for slower weapon speeds and can be a viable approach when strategic warning of a conflict is likely. Moreover, it is easier to outfit stealthy non-hypersonic missiles with navigation systems that are not entirely reliant on GPS. It would perhaps also be easier to design non-hypersonic missiles that could execute evasive terminal maneuvering to combat advanced air and missile defenses.

None of the non-prompt alternatives to CPGS is ideal. Each has potential weaknesses—but so do CPGS weapons. A particularly important question is whether, over the long term, stealth or speed is more likely to be able to overcome robust defenses. While this and other questions concerning the relative effectiveness of CPGS and non-prompt alternatives are probably impossible to answer with only publicly available information, they should occupy center stage in the Pentagon's internal analysis.

At a time of rising defense budgets, it might be plausible to argue that the United States should bypass these questions and simply invest in all options. In the current climate of fiscal austerity, however, such an approach is increasingly untenable. Spending should be focused on the technologies that pose the least risk of failing to fulfill mission requirements.

Before making any acquisition decision, the Department of Defense should analyze the relative effectiveness of CPGS and non-prompt alternatives. This assessment should take into account the impact of potential countermeasures as well as weapon costs, which affect how much ordnance can be brought to bear against a particular target. Meanwhile, before funding any acquisition program, Congress should require that the Department of Defense publish an unclassified summary of the results of this study.

ENABLING CAPABILITIES CRITICAL

Without the right enabling capabilities—command and control; intelligence, surveillance, and reconnaissance; and battle damage assessment—CPGS weapons could prove unusable. So far these support systems have received insufficient attention.

Current deficiencies are clearly illustrated by the difficulty of destroying mobile targets. All of the potential missions for CPGS could present this challenge, including against road-mobile missiles. Locating and tracking these weapons is very difficult, as the United States learned during the 1991 Gulf War, when it failed to achieve a single confirmed kill of an Iraqi Scud missile in almost 1,500 sorties.

Today, the most plausible means of detecting and tracking mobile targets would be through manned and unmanned surveillance aircraft operating from within the theater of operations. Using these assets to provide targeting data for CPGS weapons would, however, make little sense. If the battlespace permitted the use of aircraft for surveillance, then it would be more effective and cheaper to outfit those same aircraft with strike weapons and use them for offensive operations than to develop a CPGS capability.

Acquiring CPGS to attack mobile targets would make military sense only if the United States also developed a reliable means of remotely locating and tracking these targets. Plans for such a capability—a globe-spanning network of satellite-based radars—have repeatedly been canceled, and no program is currently in the works. Given that this capability would probably cost an order of magnitude more than the acquisition of CPGS weapons themselves, deficiencies in current enabling capabilities merit immediate attention.

Counterterrorism missions would test different enabling capabilities. In scenarios invoked to support the acquisition of CPGS for counterterrorism, the United States is generally assumed to obtain last-minute intelligence about the location of a terrorist and only has a short window of time in which to strike. It is far from clear, however, that current U.S. capabilities could verify any such intelligence quickly enough and with sufficient confidence to convince a president to strike.

To ensure that enabling capabilities receive the attention they deserve, before funding any CPGS acquisition program, Congress should require that the Pentagon conduct a comprehensive and dedicated study to identify gaps in enabling capabilities and develop plans, with cost estimates, to fill them. And to help assess whether CPGS could plausibly be used for counterterrorism, relevant U.S. agencies should attempt to identify any past instances in which the United States was unable to capitalize on intelligence about the location of a high-value terrorist solely because it lacked a prompt long-range strike capability.

BROAD INTERNATIONAL RAMIFICATIONS

Debate about the international ramifications of CPGS—indeed, debate about the program as a whole—has been dominated by a single issue since 2006, when the administration of George W. Bush announced plans to replace the nuclear warheads on Trident-D5 ballistic missiles with conventional weapons. These plans sparked concern in Congress that a state observing the launch of a CPGS weapon, Russia in particular, might incorrectly identify it as a nuclear weapon and launch a response in kind. Although plans for the so-called Conventional Trident Modification have been dropped, this issue of warhead ambiguity still dominates the discussion about CPGS.

This risk should not be ignored, especially if the United States acquired CPGS to conduct strikes on China (should Beijing develop an early-warning capability) or, much less likely, on Russia. However, the focus on warhead ambiguity has obscured other strategic risks and potential strategic benefits.

For example, highly maneuverable CPGS weapons with unpredictable trajectories could create a different form of ambiguity—destination ambiguity, which is uncertainty on the part of an observing state about whether it was the target of a CPGS attack. The use of such a weapon could spark inadvertent escalation if the observing state incorrectly concluded that it was the target of the attack. The risk would be greatest if the observing state also misidentified the CPGS weapon as nuclear armed.

Ambiguity could arise about the nature of the intended target as well. For example, China's nuclear-armed missiles and conventional anti-ship ballistic missiles are reported to share a single command-and-control system. Beijing could interpret U.S. attacks on this system as an attempt to deny China control of its nuclear arsenal even if their actual goal was to protect American aircraft carriers from Chinese conventional weapons. Such target ambiguity, arising from attacks on "entangled" assets, could be highly escalatory.

Crisis instability is also a real risk; an adversary's fears that CPGS could destroy its strategic weapons could lead the adversary to employ those weapons preemptively. "Strategic" does not just mean nuclear. In a conflict with the United States, for instance, Beijing would want to protect its anti-access/area-denial capabilities. It could do so by destroying the GPS satellites on which so many U.S. weapon systems, including CPGS, rely for navigation. Fearing this, the United States would have an incentive to destroy Chinese antisatellite weapons with CPGS early in a conflict. This threat would, in turn, give China an incentive to attack the GPS constellation preemptively to disable CPGS weapons. The result could be rapid escalation that both sides might rather avoid.

Yet, while CPGS weapons might undermine the prospects for escalation management in a conflict, they might *simultaneously* enhance deterrence. The very possibility of rapid, unpredictable escalation might have the beneficial consequence of raising the perceived costs of war and making a potential adversary less likely to transgress the interests of the United States or its allies. Deterrence might also be bolstered by the apparent perception of potential U.S. adversaries that CPGS weapons would be highly effective.

To better understand the strategic ramifications of CPGS, the Department of Defense should explore all the strategic risks of CPGS, not just warhead ambiguity. Congress should require the Pentagon to produce a report that sets out these risks along with possible ways of mitigating them.

A number of characteristics for CPGS weapons could help reduce escalation risks, including

- Different deployment areas for CPGS and nuclear weapons
- Distinguishable trajectories for CPGS and nuclear weapons
- Use of boosters with no nuclear association for CPGS
- Predictable trajectories for CPGS weapons
- Observable midcourse trajectories for CPGS weapons
- Limited CPGS deployments

No single candidate CPGS technology possesses all of these characteristics, making trade-offs inevitable. But the Obama administration does not even appear to have explored these trade-offs.

Most significantly, the administration has argued that boost-glide weapons could be distinguished from nuclear-armed ballistic missiles by their non-ballistic trajectories, thus mitigating warhead ambiguity. However, boost-glide weapons are highly maneuverable, and while their launch would be detectable by early-warning satellites, they would fly at too low an altitude to be monitored by early-warning radars thereafter. As a result, their midcourse trajectory would be both unobservable and unpredictable, tending to exacerbate all forms of ambiguity.

To minimize strategic risks if it decides to acquire CPGS, the United States should try to pursue cooperative confidence-building measures with Russia and ideally China too. The most acute Russian and Chinese fears relate to the perceived ability of CPGS to hold their nuclear forces at risk. Although there is little evidence that the United States is considering acquiring CPGS for this purpose, Washington should address these fears because they could precipitate nuclear use in a crisis. Cooperative confidence building could also address some ambiguity concerns.

One potentially powerful way to reduce risk would be to make all CPGS systems accountable in any future U.S.-Russian arms control treaty. Yet, because such a treaty is both a distant and controversial goal, the United States should also pursue less ambitious focused confidence-building measures. These could include declarations of acquisition plans, launch notifications, and inspections to demonstrate that CPGS weapons are indeed non-nuclear. Such measures could be legally binding or politically binding and could be negotiated, separately, with Russia and China.

Cooperative confidence building would probably be more effective than the unilateral and technical measures that the Obama administration has emphasized. To be fair, a joint approach requires cooperation, which has not exactly been forthcoming from either Russia or China. Moscow is preoccupied with finding a legally binding way to rein in U.S. ballistic missile defenses. Meanwhile, Beijing has not accepted repeated U.S. invitations to engage in a dialogue on strategic deterrence, the first step toward defining confidence-building measures.

To try to break the stalemate, the United States should indicate that it is willing on a *reciprocal* and *politically binding* basis to extend the scope of certain confidence-building measures—including data exchanges, joint studies, and the observation of exercises—to non-prompt weapons. Russian and Chinese fears about U.S. "strategic conventional" weapons are not only or perhaps even primarily about CPGS; they also relate to conventional cruise missiles and even gravity bombs. Because these states invest heavily in similar technologies, they have created the possibility of managing their concerns on a reciprocal basis.

Russia and China are also investing in their own CPGS-like systems. Beijing has deployed non-nuclear medium-range terminally guided ballistic missiles and is researching longer-range weapons. Moscow has stated its intent to develop hypersonic cruise missiles, though any deployments are at least a decade away and quite possibly longer. This creates the possibility—over the longer term—for reciprocal data exchanges about long-range hypersonic conventional weapons.

WEIGHING THE BENEFITS AND RISKS

The decision about which CPGS technology to acquire—if any—is complex and multifaceted. At least four general types of risk associated with each candidate technology can be identified:

- *Technical risk*—a failure to fulfill a project's goals on time and on budget
- *Political and bureaucratic risk*—an inability to generate the necessary support to sustain an acquisition program
- *Military risk*—a failure to meet mission requirements
- *Strategic risk*—an undesirable reaction by an adversary or potential adversary, particularly unwanted escalation in a conflict

The challenge now facing the United States is to assess which attributes of candidate CPGS technologies contribute to each of these risks (as suggested in table 1), to determine the relative importance of these attributes, and to compare the risks of CPGS weapons to non-prompt alternatives.

Evaluating the benefits and risks of all the competing technologies—prompt and non-prompt—is complex. Their magnitudes are hard to estimate, and comparisons must be made across categories that are in fact quite difficult to compare. Despite these difficulties, it is clear that an optimal decision about CPGS is most likely to be reached if decisionmakers consider the full range of relevant issues rather than focusing narrowly on the risk of warhead ambiguity.

For a more detailed discussion of CPGS, see 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.*

Table 1. **Attributes of Different CPGS Technologies That Contribute Significantly to Risk**

WEAPON UNDERLYING TECHNOLOGY	GLOBAL LAND-BASED BOOST-GLIDE WEAPON HYPERSONIC TECHNOLOGY VEHICLE-2	INTERCONTINENTAL LAND-BASED BOOST-GLIDE WEAPON ADVANCED HYPERSONIC WEAPON	SEA-LAUNCHED INTERMEDIATE-RANGE BALLISTIC MISSILE (BOOST-GLIDE CONFIGURATION) ADVANCED HYPERSONIC WEAPON	SEA-LAUNCHED INTERMEDIATE-RANGE BALLISTIC MISSILE (TERMINALLY GUIDED CONFIGURATION) STEERABLE REENTRY VEHICLE	HIGH SPEED STRIKE WEAPON (HYPERSONIC CRUISE MISSILE) SCRAMJET
Technical risks	• Inherently complex • Not a direct descendant of a tested design (non-evolutionary) • Unproven in testing	• Inherently complex	• Inherently complex		• Inherently complex • May be non-evolutionary and unproven in testing (depending on design)
Political and bureaucratic risk	• High cost • Unproven in testing	• High cost	• High cost • Sea based	• Sea based • Ballistic trajectory	• High cost • May be unproven in testing (depending on design)
Military risk	• Potentially vulnerable to missile defenses • Relatively long flight times • Unsuitable for signaling	• Potentially vulnerable to missile defenses • May be unable to accept midcourse target updates • Unsuitable for signaling	• Potentially vulnerable to missile defenses • May be unable to accept midcourse target updates	• Detectable early in flight by missile early-warning radars • Potential need to relocate before use	• Vulnerable to advanced air defenses • Relatively short range • Need for large number of platforms • Need to deploy before use
	• Launch detectable by early-warning satellites • Potentially vulnerable to GPS denial • Limited capability against mobile targets in the absence of surveillance assets deployed in theater				
Strategic risk	• Unobservable after boost phase and unpredictable midcourse trajectory	• Unobservable after boost phase and unpredictable mid-course trajectory	• Unobservable after boost phase and unpredictable midcourse trajectory • Similar deployment areas to nuclear weapons • Very hard to facilitate inspections (unless based on SSBNs or SSGNs)	• Similar deployment areas to nuclear weapons • Ballistic trajectory • Very hard to facilitate inspections (unless based on SSBNs or SSGNs)	• Unobservable after boost phase and unpredictable midcourse trajectory • Very hard to facilitate inspections unless delivered by nuclear-capable bombers
	• Perceived ability to hold Russian and Chinese strategic targets at risk				

Key: GPS=Global Positioning System; SSBN=ballistic missile submarine; SSGN=SSBN converted to carry cruise missiles

See table 10 in James M. Acton, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike.*