Pugwash Briefing Paper

Hypersonic Weapon Series

#6

What are the risks associated with Hypersonic Weapons?

Background

The Pugwash Foundation supported an international Pugwash workshop on hypersonic weapons, which took place in Geneva on 9 and 10 December 2019. The meeting brought together 30 international participants from various continents, including current and former government officials, scientists, engineers, academics and experts from think tanks and other non-governmental organisations.

The workshop aimed at fostering a constructive exchange of views on hypersonic weapons. Participants discussed factors driving the development, roles and purposes of hypersonic weapons, as well as the risks associated with their deployment and use.

Based on the workshop's discussions, the Pugwash Foundation produced a series of briefing papers on hypersonic weapons. The series covers the following themes:

- What is a hypersonic weapon?
- What technical challenges do hypersonic weapon raise?
- What are the current hypersonic weapon development programmes?
- Why do States develop hypersonic weapons?
- What are the roles and missions of hypersonic weapons?
- What are the risks associated with hypersonic weapons?
- How to mitigate the risks associated with hypersonic weapons?
- How to counter hypersonic weapons?

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What are the risks associated with hypersonic weapons?

Increased risk of nuclear war

HCMs and HGVs contribute to an increased risk of nuclear war for several reasons:

Warhead ambiguity

The uncertainty of whether a hypersonic delivery system carries a conventional or a nuclear warhead is referred to as 'Warhead ambiguity'. Warhead ambiguity thus involves the risk of confusing a conventionally tipped HCM or HGV with a nuclear one.

This may prompt a country to respond to an incoming conventional hypersonic strike with a nuclear retaliation.

There is also a risk that countries may respond with nuclear retaliation regardless of the type of warhead. Because conventional HGVs and HCMs may be perceived as capable to exploit the vulnerabilities of nuclear deterrents and to disrupt military infrastructures and networks on which the functioning of key defence assets is based.

Target ambiguity

The high manoeuvrability of HCMs and HGVs allows them to change course after launching. This makes it impossible for other countries to forecast the final target.

It may prompt a country to assume that its strategic assets are being targeted by an incoming hypersonic strike and decide that a nuclear retaliation was warranted.

Heightened threat perceptions

Depending on their number and location, HCMs and HGVs could constitute a threat to a country's nuclear or strategic conventional forces.

These heightened threat perceptions create additional pressures for nuclear weapon states to lower the nuclear threshold by delegating authority to low-level officers, adopting launch-on-warning postures or even using or threatening to use nuclear weapons for fear of losing them.

However, it is difficult to anticipate at which point, numbers and locations start making a difference in the threat assessment process at the strategic and tactical levels. And what changes in posture such a modification of threat perceptions might generate.

A low number of HGVs and HCMs deployed in a given theatre of operations would probably upset the regional balance of power. Whereas a large number deployed across a wide-range of forward- and rear- bases would be required to upset the strategic balance of power.

Shortened reaction time

Hypersonic Glide `Vehicles (HGVs)

Different scenarios see a variable reduction in reaction time between HGVs and traditional ballistic missiles:

- No reduction in reaction time – The HGV is detected in its boost phase and tracked throughout its mid-course
- Limited reduction in reaction time – If one loses track of a HGV after its boost phase, they may not have sufficient warning time to prepare for defence effectively.
- Important reduction in reaction time – If the boost phase of a long-range HGV is not picked up, the reduction in reaction time will be important. Due to the earth's curvature and HGVs low trajectory, ground-based radar will be able to pick up HGVs only very late in their mid-course phase.
- Very important reduction in reaction time - Even within reach of ground-based radars, the layer of plasma may make a HGV unidentifiable, depending on the radars' frequency, in which case the reaction time would be even further compressed.

Hypersonic Cruise Missiles (HCMs)

HCMs fly at lower altitude than HGVs which makes them stealthier than HGVs. Reaction time for a HCM would then be lower than a HGV.

Their higher cruising altitude makes HCMs slightly easier to detect than traditional cruise missiles (provided that the layer of plasma does not inhibit detection). But their hypersonic speed may offset the fact that they fly higher, leading to a reduction in reaction time in the end.

In sum, it is currently unclear if and how much the use of HCMs and HGVs would compress the response time in the event of an attack.

However, any compression of the timeline across the detection, assessment and response process, even if it were only a few minutes, would provide less time for accurately assessing the origin, destination and payload of a HCM or HGV.

Yet, this information is critical for selecting the appropriate type of response. Thus, a shortened reaction time would not only result in increasing uncertainty and risk, but also the need for greater reliance on automation and artificial intelligence (AI) in critical decision-making process, including the decision to launch nuclear weapons.

AI involvement in this process would in turn raise a number of important questions of political, military and moral nature.

Encouraging nuclear brinkmanship

Hypersonic missiles, because they are difficult to detect by early warning systems and difficult to defend against, may aggravate the competition in risk taking and lower the threshold to engage in nuclear brinkmanship, with unpredictable consequences.

Fuelling an arms race

The introduction of HCMs and HGVs, even if it were only for defensive purposes, may be perceived by some countries as threatening their own national interests.

This may prompt them to further develop their own HCMs and HGVs, and upgrade or expand their missile defence systems.

In which case, the potential initial stabilizing effect of enhancing second-strike capability and strategic balance could be short-lived.

Increased proliferation risks

Developing HCMs and HGVs requires prior knowledge and infrastructure for advanced traditional cruise and ballistic missile programmes.

It would therefore be very difficult for a country without advanced cruise and ballistic missile capabilities to develop and/or operate HCMs and HGVs. This makes vertical proliferation the most likely type of proliferation in the near to medium term.

Even if horizontal proliferation is considered less likely than vertical proliferation in the near to medium term, some horizontal proliferation risks remain. These include:

- Development of indigenous hypersonic programmes which would be immensely challenging
- Downhill transfer of hypersonic technology to lower-tier military countries with already established missile programmes
- Sales of hypersonic systems to allies
- Transfer of commercial hypersonic technology to lower-tier military countries with already established missile programmes. Private companies develop hypersonic technology for rocket launches and space shuttles (e.g. ESA IXV, Dream Chaser and REL Skylon) which may make the technology cheaper and more accessible in the medium- to long-term.

Conclusion

HCMs and HGVs contribute to an increased risk of nuclear use for several reasons:

- Warhead ambiguity
- Target ambiguity
- Heightened threat perceptions
- Shortened reaction time
- Encouraging nuclear brinkmanship
- Fuelling an arms race

Ultimately, the introduction of HCMs and HGVs is likely to result in lowering the nuclear threshold and increasing the likelihood of nuclear use whether by intent or accident.

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