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Military technology

The unsheltering sky

Even with new technology, America's multi-billion-dollar efforts to build a shield against long-range ballistic missiles looks doomed

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AS TEST flights go, FTG-06b was a dazzling affair. The mission was part of a programme called Ground-based Midcourse Defence (GMD), which is supposed to provide America's main shield

against intercontinental ballistic missiles (ICBMs) with a range beyond 5,500km (3,418 miles). FTG-06b involved the launch (pictured opposite) on June 22nd from Vandenberg Air Force Base in California of a hypersonic interceptor. It successfully annihilated an unarmed warhead which had been fired into space from a US Army site on Kwajalein Atoll in the western Pacific Ocean.

The warhead was tracked by two American naval vessels: a destroyer equipped with an Aegis anti-missile system and a $900m floating offshore oil-rig, which had been kitted out with a highly sophisticated active phased-array X-band radar. Far more powerful than conventional radar, the X-band system can calculate—with the help of some big computers in Colorado Springs—the size, shape and trajectory of a baseball-sized object 4,000km away travelling at 32,000kph.

Twelve years ago the United States withdrew from the Anti-Ballistic Missile Treaty, a 1972 deal that limited the testing and deployment of anti-ICBM weapons by America, the former Soviet Union and, later, Russia and some ex-Soviet republics. Since then, most technological advances in such systems have been in America, where the Missile Defence Agency (MDA) has spent some $98 billion on various projects since 2002. Although China appears to be working on an anti-ICBM system, Russia is the only other country with such a programme—and it is far less capable, says Jeffrey Caton, a former US Air Force colonel and space-warfare specialist.

Meanwhile, the threat grows as potential attackers continue to acquire “more complex, survivable, reliable and accurate” ICBMs equipped with countermeasures, Vice-Admiral James Syring, the MDA’s boss, told Senate lawmakers in June. Next year Iran could have a ballistic missile able to reach America, he added. But others think that is at least several years away. North Korea is also testing rockets and satellite systems which could carry a nuclear warhead. Arun Prakash, a former chairman of India’s Chiefs of Staff Committee, sees the one-upmanship between offence and defence systems as “a ding-dong battle” with the defender at a perpetual disadvantage because it is far easier to build a missile than shoot it down.

Despite the success of FTG-06b the prospects for a truly effective defence against ICBMs appear as far away as ever. GMD alone has already cost America more than $40 billion. Yet until June it had failed all five intercept tests conducted since 2008, even though each was meticulously “scripted for success”, in the words of Philip Coyle, a former White House science adviser to Barack Obama.

When things go wrong

The GMD system consists of an “exoatmospheric kill vehicle” with steering rockets and its own X-band radar system. The kill vehicle is made by Raytheon, a big American defence contractor. Other companies involved in the project include Boeing, Orbital Sciences and Northrop Grumman. The kill vehicle was used in two of the failed tests. On two other occasions, not counted as “tests”, a GMD interceptor failed to leave its silo.

With such a record, FTG-06b was something of “a make or break for the programme”, says Riki Ellison, chairman of the Missile Defence Advocacy Alliance, a lobby group based in Washington, DC. When he addressed the Senate Subcommittee on Strategic Forces in April, Vice-Admiral Syring admitted as much when he said that a failure of FTG-06b would force a reassessment of plans that are under way to expand the programme.

So far, there are 30 interceptors at Vandenberg Air Force Base and Fort Greely in Alaska. The MDA has begun work at Fort Greely to prepare for a field of silos that will contain an extra 14 interceptors by 2017. Even though the June test went well, GMD remains so unreliable that the expansion plans should be scrapped, says Frederick Lamb of the University of Illinois and a consultant to the Pentagon. In combat conditions seven or so GMD interceptors would probably be needed to smash

even a single rudimentary North Korean ballistic missile, reckons Mr Coyle, now with the Centre for Arms Control and Non-Proliferation, also a Washington lobby group.

It is far easier to build a missile than shoot it down

Money is being poured into developing new radar systems that could improve the accuracy of anti-missile technology. But salvaging GMD, some experts believe, might require an entirely new and larger kill vehicle. The MDA would like one, but the project would take years. It took four years (and $1 billion) just to tweak the vibration frequency of the current vehicle's four thruster rockets because they were interfering with its inertial measurement unit, says George Lewis, a researcher at Cornell University.

Stuck in a silo

There are other missile defences. So far, 30 of America's warships carry Aegis anti-missile systems, but these were designed to strike shorter-range missiles. With recent upgrades, Aegis is thought to be capable of intercepting warheads in space, in limited circumstances. With additional radar near America's east coast, Aegis destroyers in the Atlantic could theoretically intercept ICBMs coming from Europe and Asia, says Henry Cooper, who was President Reagan's missile-defence negotiator. Japan has purchased the necessary kit for its warships and a land variant, Aegis Ashore, is due to be sited next year in Romania and, in 2018, in Poland.

Shielding America from ICBMs will remain impossible for the foreseeable future, reckons William Cohen, a former American secretary of defence. A missile assault from China or Russia would overwhelm even flawlessly performing US defences. And defending against a limited attack from a sophisticated opponent would, he adds, suffer from unresolved problems.

Among those problems are decoys. After leaving the atmosphere a big ballistic missile can release, along with ten or so warheads, dozens of decoys. In the vacuum of space the decoys will travel at the same speed as a warhead. Decoys can be generated by discharging infra-red-emitting aerosols or clouds of thin wires or tinfoil strips known as chaff. A defender's radar will register many incoming objects but only a fraction contain a warhead, says Theodore Postol, a missile expert at the Massachusetts Institute of Technology. Even if decoys can be identified, each radar blip may

require several seconds or more of analysis. But time is short. With a closing speed of more than 10km a second, an interceptor must typically commit to attacking a single object at least 50 seconds before hitting it, says Dr Postol.

Among the most dangerous decoys are shiny Mylar balloons, similar to those sold by party shops, says Thomas Reed, a former secretary of the US Air Force. Made from plastic with a metallic coating, the material reflects radar. Dozens can be released in one go and inflated to look on radar just like cone-shaped warheads, adds Mr Reed. Worryingly, a warhead could be concealed in a Mylar balloon.

It is possible that nuke-carrying balloons can be detected by heat sensors because they would be warmer as a result of the slowly decaying plutonium inside the warhead. But it would not be difficult to foil such sensors on interceptors (or satellites) by fitting each decoy balloon with a small battery-powered heater.

Multiplying the problem

Decoys can also be generated by explosive “cutting cord” on the inner wall of the final booster stage of the warhead. Upon separation in space, the explosive breaks up the metal casing of the booster. “Now you’ve got 20 objects coming towards you” so good luck identifying the warhead, says Cornell University’s Dr Lewis.

America’s National Intelligence Council said in 1999 that China and Russia had devised numerous countermeasures to protect offensive missiles and were probably willing to sell the technology. A statement in May by the office of the assistant secretary of defence for research and engineering noted that the proliferation of such advanced countermeasures was rendering America’s missile defences “no longer practical or cost-effective”.

Nevertheless, many proponents of missile defence believe more research could make even the most sophisticated decoys recognisable. Decoys were used in the June FTG-06b test, but the GMD engineers knew what to expect. Multiple interceptors could be launched, one after the other, for each warhead thought to be on its way. As the first interceptor draws closer to a flock of decoys, it could relay increasingly accurate data to a following interceptor to hit a warhead that has been identified as real.

For now, though, no country has come close to defeating decoys, says Kingston Reif, also of the Centre for Arms Control and Non-Proliferation. This view is widely shared. Even if the hurdles are overcome, others would arise. Warheads in space could fire steel balls out in front of them to clear the way of interceptors, says Mr Coyle. An interceptor’s radar might be jammed by electronic-warfare measures or a nuclear warhead could be programmed to detonate upon detection of an approaching interceptor. A detonation in space would generate a powerful electromagnetic pulse (EMP) which could knock out electrical circuits and power grids across a continent. America’s EMP Commission, a body assembled by Congress to study such a threat, reckoned in 2008 that two-thirds of Americans might perish in the first year of a societal collapse that would follow a nuclear blast in space above the central United States.

Among nuclear powers, neither North Korea nor Pakistan is presently capable of building a ballistic-missile triggering system that is able to detonate a nuclear payload if an interceptor was drawing near, reckons Mr Reed, the former US Air Force secretary who has also designed nuclear warheads for the Pentagon. With time and enough effort, this could change. At least one type of nuclear device detonated by North Korea “is not inconsistent” with efforts to build a bomb designed for an EMP attack, says James Woolsey, a former director of America’s Central Intelligence Agency. (What is needed is not necessarily a large blast, but lots of gamma rays.)

THAADs let rip

Such an attack might not even require a ballistic missile. In December 2012 North Korea launched a satellite on a southerly track. Although it may have malfunctioned, the launch reveals another vulnerability in missile defences which could be exploited for an EMP attack, reckons Mr Woolsey. If a nuclear device was fitted into a subsequent southerly launched satellite, it would circumvent America's defences against long-range weapons because these are positioned to hit warheads flying from over the North Pole, not those coming from the south. Moreover, a nuke concealed in a satellite in an orbit used by many civilian satellites could be detonated on a flyover above America. There is no point in having a missile-defence system that cannot prevent such an attack, says Mr Woolsey.

It might, however, be possible to shoot down missiles or rockets before they reach space and eject decoys or place a nuke-carrying satellite in orbit. Proponents of "boost phase" defence, as it is called, point out that during its ascent a missile is easier to hit because it travels slowly and presents a large, easier-to-pinpoint target thanks to un-jettisoned fuel tanks and the heat from its exhaust plume. Another plus is that if it is hit by an interceptor soon after launch, the missile's payload and debris may fall back on the country that launched it.

The tricky bit is placing interceptors close enough to reach the missile before it leaves the atmosphere. Ronald Reagan hoped to put them into low orbit, but the "Star Wars" scheme, as it was known, would have required legions of satellites costing many billions of dollars. Another problem with the Strategic Defence Initiative, to use its formal name, is that satellites can be shot up or blinded with Earth-based lasers. There is also a danger that the lasers might "fall into radical hands", says a military adviser to a European head of state. The adviser, who insisted on anonymity, added that there was concern about debris from destroyed anti-missile satellites knocking out other satellites. In a 2007 test China shot up one of its defunct weather satellites, creating a huge increase in the space debris threatening satellites today.

The notion of arming satellites for boost-phase defence now has “zero mainstream adherents”, says Brian Weeden, a former ICBM launch officer who spent four years, as he puts it, “on alert in Montana waiting for the end of the world”.

There is another technology taking to the sky in increasing numbers that could play a role: using drones to launch interceptors. Dale Tietz, a former senior Star Wars official, says that North Korean missiles could be prevented from reaching space by just three interceptor-armed Global Hawk drones flying above international waters near the hermit kingdom.

David Trachtenberg, a deputy assistant secretary of defence for missile defence under George W. Bush, believes that America should spend more on developing interceptor-armed drones. But flying drones close enough to launch sites without penetrating enemy airspace could be difficult. Iran is probably too big for drones to patrol successfully because launch sites could be located deep inside the country. Even in places that could be patrolled, drones would need fast reactions. Last year America’s National Air and Space Intelligence Centre reported that the North Korean regime was developing a solid-fuel missile. Replacing its present liquid propellants with solid-fuel would greatly reduce North Korea’s launch preparation time as well as the time—roughly five minutes—which its missiles take to reach space.

Might aircraft-mounted anti-missile lasers work? A few years back the Pentagon cancelled a Boeing-led airborne-laser programme, in part because the modified 747 airliner’s bulky chemically generated laser had a limited range. Solid-state lasers may perform better. The MDA believes that drones carrying lasers will “play a crucial role” in defeating ICBMs during the boost phase. Experiments have begun with General Atomics’ Reaper and Boeing’s Phantom Eye drones.

Sitting ducks

But slow-moving aircraft would be “sitting ducks”, as Dr Lamb puts it, for anti-aircraft systems like the Russian Buk that downed Malaysian Airlines flight MH17 over Ukraine in July. Recent decades are “littered with the wreckage” of failed boost-phase shoot-down schemes, says David Montague, a former head of missile technology at Lockheed (now Lockheed Martin). He co-authored a National Research Council report two years ago that advised the Pentagon to give up on the idea.

A different approach could be the US Army’s Terminal High-Altitude Area Defence system (THAAD), which became operational last year in Guam, home to American troops in the western Pacific Ocean. THAAD will also be exported; the first will go to the United Arab Emirates by the end of the year. But THAAD, like America’s Patriot missile batteries and other missile defence-systems outside of the United States and Russia, such as Israel’s Iron Dome air-defence system, were developed to hit shorter-range threats and cannot intercept ICBMs in space. A THAAD might score a hit during the final approach of an ICBM, but the launcher would need to be very close to the targeted area.

Tellingly, in the remarks he made to lawmakers in June, Vice-Admiral Syring referred to the MDA’s “overriding goal” as defending American troops and military sites. That comment, together with the present state of the technology, suggests, for now at least, the prospects for protecting much of the United States from ICBMs or satellites secretly armed with nuclear weapons look doomed.

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